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ABSTRACT

To address the challenges to education posed by the new information technologies, participants from 41 states--publishers, administrators, teachers, subject specialists, and leaders from the field of educational computing--gathered to share ideas and visions. This report of the conference proceedings includes introductory comments by John Roach of Radio Shack and Lorrin Kennamer and Nolan Estes of the University of Texas at Austin, and four keynote speeches: "Technology: Developing Our Newest and Greatest Resource" (Donald J. Senese); "Excellence and Equity: Toward the 21st Century" (Ruth Love); remarks by Pierre Duguet; and "From Slates to Silicon" (Patricia Albjerg Graham). The texts of 10 papers presented in "breakout sessions" are also included: (1) "Computer Literacy at the Secondary Level" (Arthur Luehrmann); (2) "Computer Competencies for School Administrators" (Jim Poirot and Ted Mims); (3) "Before You Use It, You Have To Choose It: Purchasing Considerations" (Don Roberson); (4) "Planning for a Computer Curriculum" (Ruth E. Randall); (5) "Communications and the Computer: An Application Study" (Thomas E. McCann); (6) "Foreign Language: Does Your Computer Speak French?" (Betje Klier); (7) "Teaching the Talented and Gifted" (Marianne Marrapodi); (8) "Special Education Software" (Victor Fuchs); (9) "Copyright Issues for Electronic Publishing" (Carol Risher); and (10) "Beyond Instructional Computing: Preparing Students for The Electronic Age" (Michael N. Milone, Jr.). (THC)

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THE LONGER VIEW

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TECHNOLOGY and the LONGER VIEW

PROCEEDINGS:

The First Annual National Conference on

TECHNOLOGY AND EDUCATION
April 19-20, 1984
Ft. Worth, Texas

Edited by: Betje Klier
Nolan Estes
Michael Thomas

The University of Texas at Austin
College of Education
Continuing Education Program
Michael Thomas, Director

with

Tandy Corporation
Radio Shack Education Division

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The challenge

Changes in educational structures, stemming from new information technologies, challenge educators to be aware, informed, flexible, and responsive.

The conference

To address this challenge the College of Education, Continuing Education Program of the University of Texas at Austin and Tandy Corporation jointly sponsored the National Conference on Education and Technology in Ft. Worth, Texas, in April 1984. Publishers, administrators, teachers, technically competent subject matter specialists, and leaders from the field of educational computing were brought together to share impressions, ideas, information, and visions. In an atmosphere of Texas hospitality, participants from 41 states discussed a wide range of topics which could be compared to a computer-generated kaleidoscope.

The proceedings

Endeavoring to retain the informal style of the presentations of the expert presentors from many states and several foreign countries, this publication reports the conference proceedings. Our sincere thanks go to these nationally and internationally recognized speakers for their invaluable contributions. It is hoped that this volume satisfies the numerous requests which followed the conference.

Betje Klier

Conference Editor

PART I

INTRODUCTORY COMMENTS

John V. Roach

Tandy Corporation

John Roach serves Tandy Corporation as President, Chief Executive Officer, and Chairman of the Board. He is a graduate of Texas Christian University where he is now a member of the Board of Trustees. A member of President Reagan's Advisory Council on Private Sector Initiatives, John Roach was selected as the Wall Street Transcript's Best Chief Executive/Audio-Video Home Products in 1983 and as Financial World's Chief Executive Officer of the Year in 1981.

Certainly technology is something that is our business and has been our business for a long time. Radio Shack started back in early 1920 when the radio was the new technology product. In fact, our name came from that new technology product being used first on the ships at sea for communication purposes. They had to build a structure, a shack, on the top of the ship to protect this new high technology equipment from the ocean. Starting in the port town of Boston, the name Radio Shack evolved. Since that time until today, virtually everything we sell has been the latest thing in technology sometime in the last 60 years. That is what makes our business so exciting. The dynamism of technology and the rate of change is absolutely increasing, and that gives us and all of you new opportunities, new problems, and new challenges.

Of course, technology in education is continuing to grow rapidly as school districts throughout this country renew their quest for quality education. I think the President has done an excellent job in sensitizing the public to the many needs of education. He has certainly created an atmosphere where partnerships between business and education are more common. I think this is something that is very helpful and very needed,

and these partnerships will be a major factor as we all try to improve the quality of education throughout the nation.

Parents today are beginning to feel that computers are as important as the 3 R's. School administrators may be dealing with some new folks, computer manufacturers, software houses, and educational publishers, as they implement the computer both into the classroom and into the office. However, the revolution that is going on in education is just a segment of an ever greater revolution in society with regard to computers, information, and communication. Computers are in the process of becoming pervasive in our lives. The reason they are becoming pervasive is their obvious utility. Computers are a productivity tool that can make our work more meaningful, our analyses more complete, and, in general, computers can force a whole new level of organization into our activities.

Unlike inventions of other eras that gave the user an advantage which was primarily mechnical, the computer provides us a mental advantage with a lot of benefits in the classroom. This new productivity tool should be non-threatening to the educator, viewed as a supplement to the teacher's traditional activities. While the teachers themselves must become comfortable with these new tools, ultimately all educators will be the beneficiaries as computers augment both the teaching and the administrative processes. Obviously many sources of training and software are needed for educators to be able to accomplish this transition. Educational publishers are among those people who have had to make a change, and are adapting their traditional role in offering computer supplements and testing in conjunction with text materials. Clearly an educated person in the last

half of this decade will consider word processing, electronic worksheets, and data base management programs to be tools of their future achievements. It is just as obvious that in order to use these tools, the educated person must have learned to construct meaningful communicative sentences, to formulate a problem and understand the solution, and finally, the educated person must be able to read and interpret the output created whith these tools.

Technical aspects of computers and programming need to be understood by only a few, although the sequential logic of programming should continue to benefit those who will use machines to improve their ability to use them. If you look at the microcomputer industry, the maze of advertisements and product claims, media issues and user needs, can be very confusing. A lot of these confusing factors are simply that. More pertinent facts become the realities of the marketplace. Which manufacturers have sold a million machines or more? Which manufacturers have a clear, consistent, long-term policy for educators? Which manufacturers have sold hundreds of thousands of computers to schools? Which manufacturers have educational publisher support? No more than 4 manufacturers' names can be listed as answers to any of these questions, and sometimes only one or two. Clearly, relying on the facts simplifies the maze.

Another questions of today is the 8 bit machine versus the 16 bit architecture. This argument tends to confuse and really should not be an issue. Certainly a good, well supported 8 bit machine is and will continue to be a better machine than a low-performance 16 bit machine. In many

applications today, the execution of 8 bit software is actually faster than on some 16 bit machines. For many applications in the schools, the number of workstations that can be provided is more important than whether or not they are this architecture or that architecture. In other words, the true value often lies in the ability to expose the maximum number of students to the computer.

In our own particular case, we are rather proud of what is happening with the TRS-80 Color Computer 2 as it rapidly increases in importance in education, starting first in the elementary level, but today going through the college level. People are really recognizing what it can do and how well it can do it.

For the last fiscal year, Tandy sold over 100,000 units of computers to schools. Our Model III and Model 4 were the best sellers to schools. This year, though, while the number of units will increase substantially, the Color Computer 2 is rapidly gaining popularity on the Model 4. Both machines have clearly earned such an important place in education that we feel educators can feel comfortable that they will be available as long as there is a demand.

I am not bashful about putting in a commercial. You may make think this is a non-commercial appearance, but I don't make any of those. We believe that our Color Computer 2 is the absolute best value available when you consider hardware/software features, training, and support. Just like the rest of our line, our Color Computer 2 will continue to improve in performance and price just as it has in the past.

Tandy has a major stake on the questions of both computers and education. Please consider that for just a moment, and look at the facts I will help you interpret. Tandy is selling computers at a rate of over a billion dollars a year and has maintained its traditional levels in profitability through all the uncertainties in the industry. Based on these facts alone, realities of the market indicate that we are absolutely in the business for the long term, and in fact, we have no choice but to be in business for the long term. I believe our commitment to education is unsurpassed in the industry, and certainly it is our intention that it be unsurpassed. Bill Gattis is the vice president of our education division of about 70 people solely devoted to the educational marketplace.

Regional Educational Coordinators serve as a local resource for our customers and prospects. We introduced 45 new Radio Shack educational software packages in the last 12 months. Over 10,000 teachers a month continue to come to our Computer Centers for training, bringing the total to nearly 400,000 to date. Over 35,000 schools have accepted America's Educational Challenge where we offered to provide audio visual materials for staff development to all schools who wish to avail themselves of the opportunity. Our Educational Grants have been awarded to hundreds selected from among thousands of applications. Of course, our co-sponsorship of conferences such as these and our planned sponsorship of the National Student Parent Mock Election are other evidences of our continuing commitment to education. Our natural link to education is possibly our very, very real, close physical proximity to literally every school and district in America. We feel that all these things ensure us a meaningful future in education.

In fact, in many respects it's Tandy's uniqueness and self sufficiency that works in some cases to our disadvantage in some of the media. There is no battle for shelf space by other manufacturers in our stores! Software writers who get our business love us, but those who don't have no interest in us. There is no question of shake-out, because we are obviously a survivor. There is no question about maintenance or support, because we do it. It is an interesting fact that often school districts with a political requirement for objectivity are our best customers.

Clearly, we have a long-term commitment to education. Not only do we feel a strong moral responsibility to help where we can with education; we also have found many opportunities to utilize the corporate resources in fairly unique ways to help the educational community. While you can argue (certainly I would not disagree) that it has certain economic benefits for the corporation, there are certainly other corporations which do not necessarily have the same opportunities to help, and have not taken advantage of the opportunities that present themselves.

Nothing is more important than the revolution we are living through. It is really a type of Industrial Revolution, which is not the right name for it, clearly. Who knows what name the historians will give us? But when you take in the perspective that almost every American in the course of two decades from 1977 to 1997 will become computer literate and utilize computers in their everyday lives, we are going to live in an exciting world.

Lorrin Kennamer

University of Texas at Austin

Dean Kennamer provides leadership for the graduate program in education of the University of Texas College of Education, a school among the top 10 in public institutions in the nation. His doctorate is from Vanderbilt/Peabody. Dr. Kennamer's life has been distinguished by teaching excellence, administrative ability, and nationwide service to the fields of education and geography.

More than likely, I am later than most of you in the endeavor to become computer literate. I find it very dramatic and thought provoking, what Chairman Roach was saying about the type of revolution we are in.

We have all heard of Silicon Valley. There, they've been deep within the Revolution Information Age and, taking note from an article in the New York Times, one of the writers for a journal on the west coast has gotten concerned about people in Silicon Valley who are deeply immersed in the development of software and hardware, because of the way their language is changing. Now, I am not suggesting that at the end of this conference you talk like that. This writer does give us warning that some of the people are so deeply involved in Silicon Valley that they are becoming illiterate in the English language as they change it to fit their knowledge of computers.

For example, unhappy with the way her job was going, an engineer with one of the silicon conductor makers in Silicon Valley went in to see her manager. Later, she told a friend she had "core dumped" on her boss. (Translation: she had gotten everything off her chest about her job.) She

might have added that the experience was a "gating" event, the crucial turning point, again taken from "computeracy."

We have heard words which are now popular, such as interface, input, access, and format. I am "interrupt-driven," one might say. He is a "read only memory" person. (Be ready to fight if you call someone that!) He is "pushing things on the stack," and "user friendly." New languages are coming, as are new skills and new interests.

Mr. Berry, the editor who with tongue in cheek expressed these concerns, has a fantasy about a new language made from merging two California tongues. We all learned many years ago to watch California very carefully because so much starts there and comes this way. He is afraid that "computeracy" and "California psycho-babble" will get put together. A conversation might go like this:

Babble 1: I am starting to relate to what you are saying. At first I was as down as my computer is when power strikes and bad vibes surge through the lines and don't go with the data flow. But now I think I am beginning to feel a sense of wellness about this thing.

Babble 2: Yeah, and you know if you think of bad vibes on a powerline as an analog to bad vibes in the central nervous system, you 've really accessed something important. People are really computers. They feel good, they feel bad, just like you and me. They relate to each other and interface with each other. People interface with each other; people interface with computers. Really cosmic parameters.

Babble 1: Wow! I am accessing it!

So there is something going on across the face of this land.

I read this the other day in the Journal of the American Association of Higher Education. It was really thought provoking for me because of this age we are in, and we are already in it, and trying to be students of it.

Each morning on 7th Avenue in New York City in the heart of the garment district, an employee comes to work, puts on his white work coat, and steps up to his work table. He unrolls the bolt of cloth he is to work on that morning. After he smoothes the cloth out on the table he examines it to see if there are any imperfections in the cloth. Hovering over this table is a device that looks a little bit like the movable x-ray machine that you see in your doctor's office.

In fact, it is very much like that because it has in it a flashlight bulb that casts a cross hair down onto the cloth. Now the employee in examining the cloth sees an imperfection. He turns a few dials and this machine which is cantilevered over the table moves automatically until the cross hair shines directly onto the imperfection. Then he presses a button on the side of the machine, and the computing machine that is connected to the device memorizes the geometric location of the imperfection in the cloth. Then he sees another imperfection and he turns the dial until the cross hair shines down on it. He presses the button, and the machine memorizes its location. When he feels he has identified

all of the imperfections in the cloth, he looks at the order form he has, and he sees he is being asked to cut, say, a man's suit, size 40 regular. He keys that information into the system. All the rules and formulas and algorithms for making the standard man's suit pattern in adjusting it to whatever the order, reside in the memory of the machine so it calculates what the pattern should be. Then the computing machine lays the pattern out on that cloth, guaranteeing that the pattern never intersects any of the known imperfections in the cloth which the employee has already identified to the machine, and allowing for the proper matching on the cloth. The system ensures that the minimum length of the bolt of cloth is used in the process. When that is done, the employee presses a button. A laser beam comes out of the device and cuts the cloth. When the man goes home at night and someone asks him what he does for a living, he says, "I am a tailor."

Things will be changing. What we used to know will possibly have the same label, but who knows how different things will be. Truly, as Mr. Roach says, we are in some kind of revolution.

In the College Board Review not too long ago, Harold Howe, who has been a spokesman on educational matters for many years, wrote a fascinating article entitled "Computers, the New Kick in the Schools." He reminds us of when television came onto the scene with predictions that television would absolutely redo the public schools and would change the classrooms of the future where you would hardly recognize them. Television might even take the teacher out of the classroom. Great talks and prognostications ensued. As we think about it today, television is a tool.

All of those thoughts and prophecies did not come true.

The problem in getting good programs (besides "Sesame Street") was very difficult and expensive. It seemed in many ways to threaten the basic organization and structure of schools. Television, of course, did impact the schools greatly, but in fact more greatly because of the time the students spent out of school in front of the television. The big change occurred because students spent so much time in front of television at home in the past that they didn't do as much reading as previously. But Howe feels very optimistic and quite different about the way microcomputers will relate to the schools and homes. We already know that there are many many microcomputers now in use in various ways. Because of the excellent programs available, with more in our future, one of the problems we had with television has already been solved.

Most importantly, the computer and the student really like each other. They are very interactive. Students sat down in front of televisions and said "show me." With a computer, they fall in love in a personal way and become partners to each other. Considering all of the factors, the microcomputer truly is revolutionary and is going to impact us in ways we have not foreseen. Conferences like this are needed periodically because everything is moving so rapidly. We appreciate very much your attendance here and your willingness to look immediately into the future and to continue looking into the future.

Technology and the Longer View

Harvard graduate Nolan Estes, former Superintendent of the Dallas Independent School District, directs the Cooperative Superintendency Program of the University of Texas at Austin where he is Professor of Educational Administration.

What makes computer technology different from other so-called revolutionary devices in education, such as television and language labs?

First, pressure for using computer technology is coming from outside the profession — from the competitive job market which requires computer skills and from the media and advertising which have created awareness of the vastuses of the new technology. Although parents and students perceive that the mastery of computers will be one of the keys to success in the near future, most of the microcomputer efforts seen thus far in our schools have come despite our own profession, e.g., we've taken software that, in many instances, has been developed by non-educators in hardware manufacturing. Never before, however, has technological pressure from outside education been such a strong and influential force for change.

Second, the cost and versatility of this new technology have put previously financially unattainable equipment into a now affordable range. A piece of equipment costing a million dollars in the sixties costs thousands of dollars today, and will cost only hundreds of dollars in the nineties. Software costing thousands in the sixties and hundreds today will be available to the consumer for tens-of-dollars in the 1990's.

Third, this technology, unlike previous innovations, will interface with other information-handling technology. Records with hard copy printers, video discs, video topic, and a host of other communication devices will allow the learner to look, listen, talk, and in return receive responses from an interactive computer.

Fourth, and perhaps the most important motivation for educators, is the ability of the computer to improve the individual instructional process. Students will be able to interact one-on-one with a piece of equipment, and unlike other technology, students can realize valuable learning experiences geared to their achievement and interest levels. In addition to computer tutoring, many students will greatly increase their productivity by mastery of generic, problem-solving software such as text-editors and spreadsheets. Large numbers of students will actually access the real capabilities of the machine by identifying and controlling the procedures of problem-solving and translating these routines into programming language.

In the short run, the educational community probably will not see unmanageably radical change as a result of the new technology. Budget cuts, federal policy, lack of computer-literate staff, inadequate software, and traditionally slow institutional responsiveness are but a few of the inhibiters that deter rapid movement/growth in to this communication mode. However, as a result of the communication revolution, our traditions, practices, and perceptions will be altered significantly.

In addition, we will develop a new set of elites as we move from being industrial to information-oriented society. In the year 2000 the alignment of world powers is expected to depend upon nations that have mastered and made the most effective use of new technology. Thus, the need to produce a computer-literate generation is the current challenge for educators, not only in the United States, but in the entire world.

Computer literacy encompasses a variety of learner objectives, stemming from acknowledging and accepting the evolution and power of this technology, establishment of a level of comfort in its use, application to all aspects of the educational process, and awareness of its impact on the learner and society. We cannot forecast with accuracy what tomorrow will bring, but we can, as leaders, help shape the future by the decisions we make today.

Terrel Bell, former U.S. Secretary of Education, has aptly stated that unless we integrate the microcomputer technology into our school operations, this new technology may become a competitor rather than a helper. Tom Pyzant, Superintendent of Schools in San Diego, California, echoed this sentiment recently: "Unless those of us who are responsible for providing leadership in education have the longer view than in the 90's," he said, "we in public education are going to be doomed to an unending struggle. That longer view can only be shaped by a vision of the future."

We can expect, in the near future, to have more of the same uses of computers known to us as in the early 80s, they will comprise a broader

base. We will use microcomputers to (1) improve basic skills, (2) assist us in increasing computer literacy and awareness, (3) become more efficient in our administration of our organization but not necessarily more effective, and (4) make more information available to our decisionmakers.

In the long run, there will be a number of significant changes for us to consider. Many aspects of learning will be decentralized and move out of the immediate control of teachers and not depend on physical proximity. The school curriculum, as we know it, will be available to parents and students for home use; between 30 and 60 million microcomputers will be found in American homes by 1990. By that same year, it is predicted that Texas students will be issued a notebook-size microcomputer along with their textbooks. Our schools could replace many workbooks and textbooks with computer software.

Worldwide instant storage and retrieval systems will permit schooling to take place anywhere, any time, with two-way communication with anyone. Middle-class and affluent families might choose to teach the basic skills at home.

By the year 2000, computer literacy will replace reading as the top priority in our schools. Reading will continue to be very important, but will assume its place as a subskill of computer literacy, perhaps along with typing.

According to Billy Reagan, Houston Independent School District Superintendent, within the next five years students in Houston will use

computers to do most of their homework. Reagan predicts that the workbook will be the first print media to be replaced by the electronic media to be replaced by the electronic media, and textbooks will follow. He reports that parents are buying computer systems in record numbers, and, as a result, the district is modifying homework to accommodate the new home communications centers.

Learning to Learn

Just as the print media of 500 years ago did not replace the oratorical requirements or importance of the teacher, this new form of educational technology will not render the teacher obsolete. Hopefully, the teacher can relinquish some routine tasks to assume more functions of guidance in learning. Technology will change or alter the way we do business in the classroom. However, the emphasis in the next decade will be focused more on learning how to learn than on the acquisition of information.

Teachers will be helping students to learn how to classify and reclassify information, to change categories, to move from category to category, to switch from concrete to abstract information, and to look at problems from different viewpoints. In essence, teachers will focus on how to teach students thinking processes, evaluation techniques, and broadening education horizons. Students will learn how to manage their own learning.

Concerning cost-effectiveness, time is on the side of technology. The per-pupil cost of public education in the U.S. has been steadily rising

at 10 percent per year compounded over the past 10 years. Computer technology costs, on the other hand, have been dropping at the rate of 25 percent per year over the last 20 years.

Will this new technology be affordable? When you envision the many possibilities of synergistic linkage of communication and computer capabilities, the answer is yes. Book libraries, paperless news (teletext), teleconferencing, and portable language translators are but a few of the mind-boggling and ultimately money-conserving options for educators.

Computer and Curriculum

The school of the future—and the school of today—should focus on giving students the skills to cope with change. Living successfully in the year 2001 will require men and women who can make critical judgements, who can weave their way through novel environments, and who are quick to spot new relationships in a rapidly changing reality.

A prime objective in the year 2000 will be improving the individual's "cope-ability," the speed and economy with which the person can adapt to continual rapid change.

Understanding the past and understanding the present continue to be important goals of the educational process. However, the here-and-now environment will soon vanish. Therefore the emphasis must shift to learning to make repeated, probabilistic, and increasingly long-range assumptions about the future. A key to coping will be developing the habit of anticipation.

School administrators are being challenged as never before. Clearly we are at a crossroads. This new technology will demand far-reaching changes in all areas of education. Changes have been faced before, and are the essence of the challenge of the educator. How can the decision-makers address themselves to the vanishing present and gain the skills and vision needed to make choices now that will keep us from being "doomed to an unending struggle?"

The desire to help form the vision of the future prompted the University of Texas and Tandy to sponsor this conference. Jim Poirot describes many of the skills needed by administrators. Breakout sessions address many of these needs. For example, Carol Risher spoke directly to the objective of "a working knowledge of copyright laws as they apply to educational computing." Arthur Luehrman characterized in depth "the computer as an object of instruction, as an instructional medium, and as a problem-solving tool" and took his audience into the question of equity in the computer's role in the educational system. Thomas McCann explains the academic experience with computers and how educators can teach students to be more flexible in the face of the inevitable changes of the future.

Each of these conference presentations offers the unique view of the presentor. McCann wants us to "run the student up and down Bloom's Taxonomy as many times as possible" to help him learn to learn and cope. He presents us with a model which we have imitated in this conference.

Nolan Estes
Betje Klier
Deborah Verstagen
The University of Texas
at Austin
College of Education

PART II

KEYNOTE SPEECHES

"Technology: Developing Our Newest and Greatest Resource"

Dr. Donald J. Senese

Dr. Senese is the Assistant Secretary for Educational Research and Improvement for the U.S. Department of Education in Washington, D.C.

Probably, the greatest dilemma facing educators today is trying to determine what the world of work will be like as few as 15 or 20 years hence. One of the functions of the schools is to prepare the young people of our nation today to become responsible members of society tomorrow. An essential part of that function includes preparing them with a means for earning a living. The schools must be prepared to train, or at least ready for training, future job holders.

Today, that is not a simple task. The job market of the future, even the near future, is not as easy to estimate or predict as it once was. Obviously, there has always been some difficulty in being precise as to occupational opportunities and needs. Consequently, there have been times when we have had too many engineers and/or not enough nurses and too many teachers of English and not enough teachers of mathematics. These difficulties, however, have been temporary, and one cannot say they are due to improper career and professional guidance by the schools. As the supply and demand nature of the job market applied itself to these situations, these temporary problems disappeared in a relatively short period of time.

The problem we are facing today, however, is not so precisely delineated nor is it going to be so simply solved. In fact, not only can we not predict demand in certain job areas, we do not even know what some of the jobs of the future decades will be. Some jobs which exist now will soon be eliminated while others jobs loom on the horizon waiting to be developed. It is difficult to prepare an individual for a career that at this time is not even visualized or may depend on certain unforeseen developments in other fields.

To further complicate matters, it is most likely that this shifting pattern of job and/or career needs will continue. Up to almost the present decade, the education and training which one took in preparation for a career would prepare that individual, with perhaps only occasional updating, for a lifetime in that career. This is, quite simply, no longer the case. It is estimated that training for many careers, in the near future, will last only 10 to 15 years. A large segment of the population is going to need a career "re-training" every 10 to 15 years. We many need to prepare individuals for three or four career changes during a lifetime.

What this presents to educators is both a challenge and a dilemma. Somehow, while many were unaware that it was happening, we have stepped out of our present "industrial age" and over the threshold into the "information age." The Information Age, and its adjunct the computer, is here—now! Nobel prize winner and University Professor at Carnegie-Mellon University, Dr. Herbert A. Simon has placed the development of the computer in this perspective in a speech before a conference of educators in

November of 1982 (Computers in Education: Realizing the Potential, Washington, D.C.: GPO, 1983, Volume II):

> Nobody really needs convincing these days that the computer is an innovation of more that ordinary magnitude, a one-in-a-several-centuries innovation and not a one-in-a-century innovation or one of these instant revolutions that are announced every day in the papers or on television. It really is an event of major magnitude.

And it is an event that will affect not only the way we earn our living but the way we live as well. Dr. Marvin Cetron, who has forged a career by providing research and realistic forecasts of the future for governments, businesses, and interested individuals, listed in International and Occupational Forecasting what he considered to be the "Hot fields for 2000 and beyond". The top three he cites are:

* Telemarketing (sales) workers
* CAD/CAM workers (computer-aided design and manufacture)
* Software writers

We must prepare now to offer programs in the schools that will prepare students to be functioning, literate members of an information-based society, and to provide them with the tools necessary to keep and hold a job in such a society.

We are living in the age of technology. This means that we can utilize technology to improve our way of life, and the way in which we

perform our jobs. It does not mean, however, that all new jobs will necessarily be high-tech jobs.

What it does mean is that there is a need for better education by our schools, and that there is a growing need for more and better educational opportunities after the completion of what we refer to as a "formal" education. Adult re-education is, and will continue to be, a growing facet of the educational picture.

The computer, as well as other technological innovations, can provide us with a means of offering improved educational opportunities, in a cost effective manner, to many who have not had them in the past or at least were hampered in their educational advancement for a variety of reasons--- for example: individuals with physical handicaps, people confined to specific location such as a prison or nursing home, and persons residing in geographically remote areas.

Traditional schools need to get into the act. This is not to say that everyone needs to be a computer expert or that everyone in the future will spend the bulk of their time on the job in front of a word processor. What it does mean is that we have available to us new technologies that enable us to improve education.

Educators must not be so awed by this fact that they are overwhelmed into a lack of action. There is no point in waiting until we

can do things perfectly before we do them at all. Now is the time to get started. One of our biggest assets can be research; it can lead the way. Educators can benefit from new knowledge provided by research.

Toward this end the Office of Educational Research and Improvement convened a group of forty top experts at a conference held at Carnegie-Mellon University and the University of Pittsburgh in November of 1982. The conference was an exceptional experience as these leading scholars explored the key research areas needed in using computers in mathematics, science, reading, and writing. The report, Computers in Education: Realizing the Potential has already become a major document for identifying research into instructional technology.

Also, through the National Institute of Education, we have granted an award for a Center for Technology that will focus on research.

Schools can also learn from one another through the sharing of information and ideas. Allow me to highlight some of the work of the Office of Educational Research and Improvement which contributes to the notion of sharing in the field of technology.

The National Diffusion Network identifies exemplary programs and assists school districts to adopt and implement these exemplary programs. It utilizes the knowledge of successful programs which can be used in other areas to bring information of good educational practices to other school

districts and to avoid duplication of effort. We've been able to use the NDN network very effectively in assisting the technological revolution in our educational system.

First, the Secretary of Education, who has the authority to define areas of concentration for NDN, listed technology as one of the fourteen priority areas. In this list of priorities, attention will be given for computer science programs which aim to help students (1) understand the computer as an information, computation, and communication device; (2) use the computer to enhance instruction in English, mathematics, science, social studies, or for personal and work-related purposes, or (3) understand the world of computers, electronics, and related technologies.

Second, the Secretary designated that a number of schools utilizing technology successfully should be designated by the NDN as "lighthouse schools." These schools receive extra funding to train other educators with the expectation that their experience will be replicated in other parts of the country. The response has been enthusiastic and satisfying. We now have ten "lighthouse" schools so designated with programs ranging from alternative occupation training in high technology for secondary school age students (some of whom had previously been high school dropouts) to more effective management of student records to using technology to improve math and reading skills.

An exciting new program announced late last year, and one which has been received with much enthusiasm, provided grants to twelve school-based technology demonstration projects. The funds for these grants were provided by the Secretary's Discretionary Fund. Schools were asked to identify a learning objective and devise a means where one or more technologies were used to accomplish an educational objective.

While most educators are excited about the use, and possible uses of technology, both in and out of the classroom, there has been a limited attempt to realize the full potential. The school-based demonstration projects provide good examples to follow. Through this program, we have identified excellent programs being offered, and utilized successfully, in many localities throughout the nation. This program is designed to facilitate the sharing of the best of these programs with other state and local school districts. The ultimate goal is the widespread improvement in the use of technology for educational purposes.

In announcing the awards for these projects, which together totalled more than 1.5 million dollars, U.S. Secretary of Education, Terrel H. Bell said, "The demonstrations by the selected schools will help answer many questions concerning the use of technology in the classroom. These outstanding projects will serve as excellent examples of how to use microcomputers and other electronic devices in striving to achieve excellence in education."

The demonstration sites are distributed throughout the United States: urban, suburban, and rural school districts are all represented.

Somewhat innovative in terms of grant programs--grant awards to local schools is a new approach for the Department--some examples of the high quality programs which were selected for grant awards are:

* The use of interactive technology to upgrade the knowledge and skills of physics teachers and, simultaneously, deliver high-quality physics instruction to students. This program is located in Iowa and will involve the University of Northern Iowa in Cedar Falls working with 45 secondary schools.

* In Virginia, the Fairfax County Public Schools will use an extensive array of micros to extend computer-assisted instruction to the upper grades. Examples include: teaching math/problem solving in grades 5 to 8 and science in grades 9 to 12. Further, they are going to add word processing to their curriculum in grades kindergarten through 12. They will also provide additional teacher training in the use of microcomputers.

* The Houston, Texas Independent School District will develop and disseminate technology-based programs in several areas, including computer literacy. six public and one private high school will be involved.

Other school districts which will be involved include: all Coeur d'Alene, Idaho elementary and secondary schools; the University of Arizona, Tucson and the Glazier Elementary School at Norwalk, California; Western Kentucky University, Bowling Green and 10 middle schools in a consortium of 23 school districts; Montclair, New Jersey Board of Education with 6 elementary, 2 middle, and 1 high school participating; WICAT Education Institute, Provo, Utah will work with 3 schools in Provo, 1 school in Port Hueheme, California and 1 school in a big Eastern city school system; and the Educational Communications Board, Madison, Wisconsin will involve all their local education agencies and all elementary schools in the state of Wisconsin.

These projects will be effectively monitored and reports prepared on what we have learned. These will be widely disseminated.

OERI has provided training for thousands of State and local leaders in technology through such programs as Project BEST, Project SLATE, and Project VIM.

We are also using technology, educational television, to teach science through such programs as the "Voyage of the Mimi" and, in cooperation with the National Science Foundation, "3-2-1 Contact".

We are monitoring several contracts to utilize technology to improve the teaching of basic skills in the area of mathematics, science

and writing. One of these is a unique communication program known as Project Quill which uses a set of microcomputer-based programs around which several instructional activities have been developed. The activities are geared to young writers in grades 3 to 6. Quill utilizes the microcomputer's technological capabilities to help teachers teach writing. The youngster's natural enthusiasm for anything connected with the computer strongly motivates them to write and to perform the various tasks which are a part of the program. It has helped to eliminate the drudgery of rewriting compositions by hand. Corrections and rewrites can be made quickly on the word processor and a print-out is secured. The computer is being used to help students to write better, not as a replacement for the skill of writing.

Textbook publishers can also take a leadership role in helping schools to make the most of computer usage in their educational programs by developing appropriate education software.

Improving the technological perspective of the schools is very much going to be a cooperative effort in all aspects of the endeavor.

Sylvia Charp, Editor-in-Chief of T.H.E. Journal points out in the April, 1984 issue:

"Thought must be given before buying equipment as to what will be done with the equipment, and whether there will be a need for it to become part of a network. There now exists a choice. Computers and peripherals for networking and communications will become increasingly important in

education and in industry as manufacturers, software developers, publishers and educators work together to provide economical and effective telecommunication devices and systems."

Of course, we must be mindful of the fact that no matter what other programs or initiatives we might attempt to implement in the educational area, we must not ignore basic education.

A few years back, critics viewing problems in education posed the question "Why Can't Johnny Read?" Professor Eric Zorn updated the education crisis in an article in the Chicago Tribune (AUGUST 12, 1981) when he related this problem to the technology age. His article was entitled "If Johnny Can't Read, How Will He Plug In To The Electronic World?" He wrote:

* You can call him Johnny: long-suffering mascot of national illiteracy; standard bearer of our collective disgrace; blot on Western culture.
* He still can't read very well, his writing is getting worse, and he's about to be victimized by one of the most dramatic undertakings in the history of civilization: the Information Revolution, a watershed in human development to compare with the Industrial Revolution 150 years ago and the invention of the printing press in 1440.
* The already evident truth will become more obvious: Power, for individuals and nations, is knowledge.
* Where will that leave Johnny, the person who does not have a functional ability to read or write any language?
* He will find that there are fewer jobs for unskilled workers. His world will be highly complex and interconnected, and daily life will demand control of sophisticated cable and computer technology; he will be unable to take advantage of this vast technology with his so-so-skills.
* Self-styled experts will speculate endlessly "Why Johnny Can't Log On."
* His prognosis is an apt one. Without a concern for, or a conscious attempt to have excellence in education, other efforts will be futile.
* It is important that we develop our human resources to the best extent possible for our survival as a nation. We have seen documented the decline of U.S. school standards since the early 1960s: class grades have remained up but real performance has gone down. Dr. Barbara Lerner

has noted that this has occurred in a period where we have sent more of our young people to school for longer periods of time than any other nation in the world. American productivity has also declined during this period. Dr. Lerner warns that the U.S. might face the period where high level managerial, professional and scientific talent will be in short supply and consequently the U.S. may discover this situation bringing serious economic, political and social problems.

* During the projected Information Revolution of the next 20 years, Johnny will be overrun by those marching to the muted, staccato drumbeats of clicking electronic keyboards.

The common person supposedly will have access to the equivalent of 10,000 mental slaves. Money will be made and business conducted by buying, selling, and trafficking in information and its complicated delivery systems.

Perhaps the significance of the challenge we face in learning was best stated by Columbia University professor Diane Ravitch in her recent work The Troubled Crusade: American Education 1945-1980. Dr. Ravitch notes:

> "To believe in education is to believe in the future, to believe in what may be accomplished through the disciplined use of intelligence, allied with cooperation and good will. If it seems naively American to put so much stock in schools, colleges, universities, and the endless prospect of self-improvement and social improvement, it is an admirable, and perhaps even a noble flaw."

And finally, the U.S. must once again regain confidence in its ability to grow and expand and develop. During the 1960s and 1970s we

experienced in our public life advocates of limited growth and limited development, a philosophy leading to lack of confidence in ourselves and our society and a malaise prevalent in our institutions of higher education. The late Herman Kahn, in his last book The Coming Boom, observed that one of the reasons he expected high and sustained growth rates through the 1980s and 1990s was because of a whole host of new technologies and technological improvements ripe for large-scale exploitation, notably computer networks.

The electronic learning, growing more and more popular, builds upon these amazing developments in society, in learning and in opportunity. The technology is here; the will to use it effectively must also be present.

I should mention that we need to be aware of the disadvantages or limits on this breakthrough — educators unwilling to change may resist; special interests may lobby vigorously against it fearing it will replace teachers; competitors may undermine it for their personal interest; and an apathetic public may fail to respond; quality of courses may be compromised in seeking a greater quantity of students; equalitarians may be dissatisfied with opportunities for access.

However, we need to recognize the great advantages — electronic learning can give greater access, more extensive educational opportunities, and an enhanced relationship between teachers and students; this

development requires no knowledge of technology except the ability to push buttons; expansion of education is related to the declining cost of technology; a great educational system can further expand developing a more knowledgeable population and informed worker and consumer. An expanded and better educated population can assist American productivity at home, and American leadership in the world.

All of you can play a vital role in this next stage of development for technology and education. As John Naisbitt writes in his final statement in Megatrends: "My God, what a fantastic time to be alive!"

Excellence and Equity: Toward the 21st Century

Dr. Ruth Love

As General Superintendent of the Chicago Public Schools, Dr. Ruth Love is responsible for 22,000 teachers, 430,000 students, 500 schools, and a budget of more than 1.4 billion dollars. Dr. Love has her Ph.D. in human behavior. Her background includes many teaching and administrative posts, including five years as National Director of the $3 million Right to Read program, and head of the Title I program in the State of California.

One is always tempted to talk about one's school system when there is a captive audience like this, but I have three colleagues here and I'm sure you've heard more about Chicago than you want to know. Dr. Blair's here and, you know, you can just wake her up in the middle of the night and she talks about computers and that sort of thing. So I know you've heard about computers and Chicago.

What I really want to talk to you about, however, is public education and where I think we ought to go as we prepare for the 21st century. Now if I slip in a few things about Chicago, you will understand that that is just part of my speech pattern. I wanted, too, to be very credible with this group so I was reminded of George Wills' three least credible sentences. You've heard those? One is, "Your check is in the mail." The other is, "Of course, I'll respect you as much in the morning."

And the third one is, "I'm from the government and I'm here to help you." Now, I really want President Reagan to learn that last one because I really need his help. However, not since Sputnik has there been so much attention focused on public education. Those of you who were around in 1957 when the

Soviet Union bested the United States technologically will recall that there was a fervor in this country, both in the halls of Congress and in the classrooms of America. Those of us who were in the classroom at that time will recall that we knew we were going to get some help, because people once again turned to education to solve a national crisis. When the Soviet Union is more competitive than we are, we have a national crisis. So we got the National Defense Education Act and it is interesting that this act was called the National Defense Education Act, because it clearly gives evidence of the fact that education plays a vital role in our place in the world. People who don't understand that — and I would like to see a few in Washington understand that now — really don't understand the whole history of public education as an institution. When I think about it, where would we be without the 17,000 school systems in this country that educate 90% of the children in the country?

Well, today we face the high technology revolution. Changes are occurring so rapidly that we can't keep abreast of what's new on the market, either in hardware or software. We haven't quite caught up with that in Congress and in the White House. Instead of the National Defense Education Act or major leadership thrust, we are getting national reports, and I just want to share with you what some of those reports are saying. I don't really criticize them too much — I just think they could have given five or six superintendents and a few teachers and principals those millions of dollars and we would have developed them a report in about five hours, since we know most of those problems. But the truth of the matter is that those reports provide for us

a window of opportunity by which to do something. If we take those reports, as critical as they are, take the things out that we can use, I think we can turn around the thinking of some of our elected officials, both at the state and at the national level.

What do they really tell us? First of all, they tell us that we ought to spend more time in the classroom -- more time, lengthen the school day, lengthen the school year. They tell us that we ought to increase our standards. They tell us that graduation requirements are lax, so we've got to tighten these and increase those. They tell us that merit pay is very important to retaining good teachers. I have to give you my opinion of some of those concepts. And there are lots of other things. We must have more math and science. We must stress it more and earlier. We must find ways to get good and superb teachers into our classrooms.

Let's go back for a minute. Nobody would argue with higher standards. Nobody would argue with increased graduation requirements. We've just included computer literacy as a graduation requirement for Chicago. We've just included two foreign languages as a requirement. Now, my friends in physical education don't think too highly of that because we have decreased the requirements from physical education from four years to two. Now that's the revolution -- that <u>is</u> the revolution, because the P.E. lobby is stronger than anything I've ever seen. But the truth of the matter is that we are violating state law, because it is a law that tells us we ought to do that.

Let's look at this whole issue of more time. I would not suggest that having more time in school would not make a difference. But I can

tell you that without more money there isn't going to be more time in school. And I would rather take us to the classroom and look at how we utilize existing time. You know, if we could maximize the time we have and be sure that teachers spent more time in direct contact with students than doing all the paperwork, and enduring all the disruptions that superintendents like me impose on them, they could really make a difference. Teachers really teach less than 50% of the time that they are in the classroom because of a wide variety of factors. So I'm not so sure that just having more time is the answer. I know that merit pay is not going to solve a problem in education. What I maintain is that we must lift the level of compensation for teachers all over this country if we expect them to perform in a professional way. It is not just to select out a few superb teachers and give them recognition, but rather to say that if you've had five years of education in college and if you've had a master's degree you deserve more than $10,000 to $13,000 as a starting salary. If you went to the private sector you could double that. So I do not see merit pay as a viable option until we have changed the pay structure for teachers. Now, I say that after having had a strike in which I was hard-nosed and didn't give much of a raise. But the reason for that is that we didn't have the money. The truth of the matter is that I think we really must look at those issues.

What did the reports <u>not</u> say? That's my real argument — what they avoided in those mini reports. I did not notice anyone addressing the whole issue of financial reform. Most of us are paid, our school systems are paid through property taxes. There ought to be a way to look at how we fund public education in this country. I worked on one of those reports myself, and I spent most of my time arguing with some folks who were not

educators on there. The truth of the matter is that we must find some alternative ways to fund public education. Otherwise, all of this reform is just going to be a lot of talk and this era will pass and nothing will have occurred.

The other issue that is clearly omitted is the issue of equity. There was no talk about how we provide for minorities, how we provide for the poor or the disenchanted, what we do about women in education. Equity issues are very important, and if we are going to prepare for the 21st century, we are going to need the brain power of all the people, of all the children in order to provide good education.

Another interesting omission was how we really attract and retain competent and good teachers. I didn't read in the reports that there was a lot of focus on what we do about that in education, and I'm very concerned about it — how we retrain our existing teachers so that they can be prepared for this high technology revolution we are about. Those are some of the hard issues. You know, it would have been tremendous if this summer, thousands and thousands of teachers could have been in school at the federal government's expense helping us to get prepared for next September when we are going to go into all kinds of new, great things throughout our school systems.

The other issue that I think they did not address is even more difficult. Over the last decade and a half, the public schools have assumed responsibilities that were traditionally carried out by the families, by other agencies. I have a friend who says we ask the public schools to do what we used to pray to God for. That is really everything.

We teach them manners and morals, sex education, immunization. We are responsible for all kinds of things instead of the three Rs. I think we have to expand our concept of basic skills, and basic skills must be expanded to include computerization, must be expanded to include thinking and analyzing. It must be expanded to include one's self-concept. That's a basic skill because that skill is going to take you farther than whether you read. If you think well of yourself, you will learn to read. We are going to have to take a look at how we teach children to respect cultural diversity. Now people don't usually think of that as a basic skill, but in my definition it is a basic skill. We learn to respect people who are different from ourselves. If you know that you live in a multi-cultural, pluralistic society and you learn that skill, I think we've got to find a new way of thinking about what basic skills are. Of course we've got to have the three Rs. We can't do any of this very well without the three Rs, but if we can mesh how we feel about ourselves, how we feel about other people, how we interact (and that means how teachers interact), how they feel, how they respect, who they value, if we lift our expectations for all children and all standards, if we find people who truly believe that all students can learn regardless of their ethnic or their economic background, I believe that we can work in the technology in a way that will help us truly reform the classrooms. That's what we're really talking about.

Today we have a number of "buzz" words -- reform is on the horizon. If you're not into reform, you are really out of it. We have excellence as another buzz word. We have fireside economics as another buzz word. We have balanced budget, another buzz word. If you really translate that into our language, it really means tuition tax credit. It

really means vouchers. It really means taking the children from public schools and finding an alternative way of providing education for them. It really means trying to have prayer as a major issue in the schools, and I'm not against prayer — when you're in Chicago facing the problems that I do, you pray a lot. But the truth is that this is not the major issue facing public education, nor is violence and assaults on teachers and students. I have a problem when our national leaders make those the major issues and throughout the country use them to politicize public education. What we really need is a national thrust to help us strengthen, reform, and build a new system.

It is true that some of our systems are still operating as they did in the 1930s. It's a fact. It's a fact that there is no excuse for graduating students who are functionally illiterate. We can't use the excuse of the kind of family they are from, or we can't use the excuse that they are poor. We can't use any of those excuses. It is our job. We must find a way to do that. We can't do that without adequate resources, without adequate support, without adequate accountability. I believe we do need systemic change. I believe we must change graduation requirements. I think they must be tough. I think they must be difficult. I think we can not afford not to change them. We must have our standards so everybody understands them, so they are clear and not bogged down in educationese. We must do that in a way that parents and community understand what we are about. We must be serious about it.

I believe that public education can meet the test of the times. As I look at what excellence is all about, I believe it really means

providing the highest quality of education to all of the students, regardless of who they are.

As we judge our schools for excellence I want to raise a few questions. One is: does the school operate as a unit? One way you get on top of any kind of big institution like my city is to break things into component parts. You can't go in and look at the 600 schools in Chicago and say I'm going to change all of these schools tomorrow, but you can break them into component parts where you can focus on them. If we use the school as a unit I think we have to ask ourselves six basic questions if we are really going to focus on excellence.

One is: does the school have strong, viable leadership? Leadership that knows how to manage. Leadership that knows how to lead. Leadership that knows and understands good education and knows good teaching.

Is the curriculum well defined? Is it a blueprint which includes the expanded basic skills of computerization and all that goes into it, or is it the same old curriculum that we have used, year in and year out? Now, I have published a few textbooks, but I can tell you that I do not believe that the textbook approach to education will take us into the 21st century. We can not have publishers determining what our curriculum will be. Educators must determine what the curriculum will be, and have the books relate to what they want to teach, as opposed to taking the books and deciding this is what we will do. For years that is what we have done in this country. We haven't determined that <u>this</u> is what we want to do and this is where we want to go. I think it is critical that we do just that.

Another question is: are our activities guided by measurable objectives that everyone understands — the teacher, the student, and the parents? Do we understand what those objectives are? Does the evaluation encompass broad variables or is just a testing program? Are we looking at all of the things we are doing and trying to access whether or not we are doing them well? If we are going to pursue excellence, that is important. Do we have competent, dedicated teachers who can not only teach the subject but also teach children the subject? That is a very different concept. You know, in high school they keep telling me they teach English, math, and science, and having taught those subjects I know the way high school teachers are trained. You are really teaching students math. You are teaching students science. It is important that we have teachers who can motivate, who can stimulate, and who are brilliant. I don't like it when I read the reports that say we get the lower one-fifth into education, because I think we have and we must continue to get brilliant people into the classrooms and keep them there.

The sixth question is have we provided for viable ways of involving parents and community in the school and the classroom activities? That means that we must give back to parents their responsibilities. We must have them do those things that they are supposed to do. I'm about ready to say no to a group that want us to feed them dinner now. I think we ought to give parents their jobs back. I think we ought to provide parent education so they understand what their responsibilities are, and I think we ought to do those things we are trained to do. That is a hard line position. I am not suggesting that we throw everything out. I know that children need support and I think we ought to provide it until we get parents prepared to provide it. I really think we have to decide what we

are willing to be held accountable for, and I'm not so sure that we can do all of the social related things that we have been asked to do over the last decade and a half, for lots of reasons.

It is difficult to find things that one can hold parents responsible for. We finally came up with one thing, with Alice Blair's help. We decided we could require them to pick up report cards. We can't require very much, but we can require that. Twice a year, parents in our school system must come to school and pick up report cards. We keep the schools open until 6:30. I was told beforehand that it won't work. Parents won't come out at night. They will not come out and pick up report cards. I want you to know that this past November when they came out (they must do it twice a year), 89.7% of the parents in Chicago elementary and secondary schools were in those schools picking up the report cards. Now, if you consider 435,000 students, what that meant to have the parents out. It's not just picking up the report cards. It's the interaction with the teachers. It's the dialogue that occurs. Teachers say they had never seen the parents before. Next week they have this opportunity again, and I will wager that they will be there, because despite what we say, most parents want their youngsters to do better than they did.

This is the first generation in which youngsters will not exceed their parents' expectations or their parents' level of performance nationwide. Consider what that says for our country. It is the first time when young people cannot expect to exceed their parents' achievement. We have got to do a lot more than catch up with Japan and Germany to correct that. Our nation is built upon improvement and progress and doing better than the last generation. It is critical that we look at the schools for

some of these answers. If we want to maintain the competitive edge, and we do; if we want to have a strong military defense, and we must have; if we want a viable industrial complex, I believe that we must not only have public schools survive but they must flourish. We must see to it that they flourish. They must flourish because the federal government, the state government, and the local government will work together to see that they do so.

It is no accident that Japan and Germany have exceeded us technologically. That is not an accident, because we all exceed at those things that we stress. They stress education. They stress technology. Japan can copy everything that everybody does. If you visit the schools in Japan you'll see why, when we make a radio, they can take that radio and make a better radio. We have got to find ways of interacting with those countries. We've got to find ways of really improving the structure of public education.

As we progress toward the 21st century, I think we have got to look at equity issues as well. We really must take a hard look. In Chicago we are about to celebrate the 30th anniversary of Brown versus The Board of Education. We are about 27 years late, because our desegregation plan is just under way. It just can't take that long to have some equalization of opportunity if we are going to maintain our competitive edge. You can't write off that many people.

We have in our system a number of viable magnet schools and specialty schools and programs that attract students. That's how we get some of these students from private and parochial schools in addition to

recruiting. I must confess, however, that I was a little dismayed to learn that my recruitment team was outside the Catholic church on Sunday morning recruiting. I thought that was taking it a little far, and so did the priest.

It is important that we upgrade those schools and we make those schools islands of excellence. We can't afford to have schools that are not excellent simply because they are on one side of the town, or simply because they are Hispanic or black. We've got to have high standards for those schools and we've got to teach those kids. We've got to see to it that they graduate as functioning adults.

What does equity really mean? We don't hear much about it any more. Two things that we don't hear much about are equity and affirmative action. They are no-no's. The truth of the matter is that, as I see equity, it really means deciding to provide good education to all of the children regardless of their backgrounds.

There are four dimensions of equity I'd like to share with you. First is access. Do our students really have access to get into schools? Secondly, achievement. How are they doing once they get into schools? Are they performing well? Do they need special help? I maintain that whatever they need, we should give it to them. That's what education is all about. Children don't grow alike, nor do they learn alike. So let's give them what they need to achieve. Then there is performance – how are they treated once they are there? Are we addressing all of the issues related to attitudes, related to behavior? Are they accepted? Are they involved? Are they trapped on the lower rung or are they expected to be on the top

rung? Finally, there is transference. Can they use what they learn to make a better life for themselves? Have they understood the informal system as well as the formal one? Do they have skills, or do they know how to learn and how to search for knowledge? That's what I believe equity means as we face the 21st century.

Our nation is really on the threshold of a new age in which I believe every citizen is going to have to meet some awesome challenges. We're going to have to compete or we're going to have to move to the sideline. The children who started to school this past September in Chicago will graduate in the year 1997. That is just three years before the turn of the century. We have to ask ourselves what kind of education we are going to provide them in the next 13 years. What is going to be different about our classrooms? Are we going to continue the same old way, or we are going to take the things that we know work very well and add to them the new things we are learning in technology? I believe we have to do the latter. Indeed, in 1997 the world will be smaller, faster, more complex, and certainly more competitive. We need to begin now to predict what skills and what knowledge they need to have in order to function in the 21st century. If we don't begin today to address tomorrow we are no better, said Winston Churchill, than those who stumble over the truth, but immediately pick themselves up and hurry off as if nothing happened. We don't want to be in that situation.

Dependable forecasting is what we've got to think about in public education. I am reminded of a story of a man who lived in Lebanon, PA, and he was considered a master at dependable forecasting. He forecasted the weather even more effectively than the weatherman did. Each morning he was

known in the neighborhood for saying, "It's going to rain, today, kids, so take your boots." "It's going to snow today," or "it's going to be a sunny day." When people would ask him how he could be so accurate with his forecasting, he'd say, "I can just feel it in my bones." Well, as the story goes, this gentleman would really go over near the train track and watch the box cars coming from Pittsburgh to Philadelphia, and if he saw that the cars were wet, and knowing the prevailing winds, he would predict rain. If he saw a bit of snow on them, he would predict snow. About 98% of the time, he was right. It didn't have anything to do with his bones. He could just see. We need some dependable forecasting in education. Confucius said that only the supremely wise and the abysmally ignorant don't change, and if we think about reform, let me just say to you that reform is a process. It is not an event. It is not something we are going to do tomorrow that is going to cause everything to be different. It is a process and we must understand that process — how we get people to start where they are and to move where we want them to go. We've really got to master that.

Pat Graham talked last night about all of the equipment off the shelves. She's right. When we headed Title I, you could go through the school systems of California and see all kinds of things locked up. That's because we didn't understand that just providing the equipment, just providing the materials, was not necessarily going to change the classrooms. You have to prepare people for change, and it is an ongoing process.

Let me just share with you a few things that I think are going to happen as we get to the 21st century. You all know that the space shuttle

will trigger a world-wide communication revolution and it will make communication through space so commonplace that a telephone call from Japan to western Europe will cost only $.50. By 1990 it will cost $.25. I'm ready for that. I've even volunteered to be the first lay person to go up into space. I don't want to remain there, but I want to check out what these astronauts are seeing because I think we ought to know a little bit more about it. They are considering taking on the next flight someone from the lay public. They are considering taking someone who can come back and communicate in lay terms what's going on. Isn't that tremendous. In our lifetime old Joe Blow might be able to go into space. That's a long way from where we were a long time ago. By the year 1990, we'll be able to receive a call or place it through a battery-powered wristwatch Dick Tracy style. That is tremendous progress.

The average computer by 1990 will do 200 million operations per second. Machines coming out in the year 2000 will do 8 billion operations per second. People will use them at home with their central terminals. Whole families will be at home, able to work and go to school at home. Never mind, we won't be out of business, because there are some things you have to learn at school, a few impersonal things, a little drill work. But we've got to be with it, because it will be a whole different way of living. So if we don't prepare for the 21st century, we are going to be out of work. Unemployment may not be too great. We've got to tailor our programs from pre-school through universities to allow for home instruction, because it's coming. I'm inviting it because I think we can do it better than anybody else. The truth of the matter is that it will be here within the next 16 to 20 years, and we've got to know what to do about

that. We've got to know how to make use of what children learn at home and how to make use of what they learn at school.

The experts forecast that we will have a checkless and a cashless society. I can hardly envision that. If I can't have my checkbook and my credit cards, I won't know how to function; but they tell me that it won't be that bad. Money will be transferred by voice print and almost nobody will have to shop in person, and I welcome that. I'm looking forward to that. The cars that we will drive will be made of fiberglass and plastic and they will be electric. They will weigh about half of what they weigh today. Imagine what the implications are for education.

Around the turn of the century, medical researchers tell me, they will have gained such command of the aging drugs, the genetic code, that they will have cracked the code so that people can choose to live to be 150 or 200 years old. Just imagine the implications for our personnel policies, for our pensions, for our recreational needs. But those are things we are going to have to think about. Are we going to need more education, different kinds of education? That is only 16 to 20 years away.

By 1990 there will be as many as 1.5 billion robot technician jobs available, and nobody will be in demand any more than the computer programmer, but that will not be the only job available. By 2000 there will be millions of new kinds of jobs that people can have. What we don't want to do is make the mistake we made in the early years of vocational education when youngsters were trained for one occupation. They must have multiple skills because there will be multiple jobs and multiple

opportunities. The most important thing that they must learn is how to adapt to change. Change will be constant and frequent.

The world of tomorrow for every student will be an exciting world. It will be a complex world and they will have to learn how to sort through and to differentiate and to make decisions. I am very worried about the decision-making capacity of our youngsters, because we don't teach very well in our schools' decision making processes. Sometimes we don't even make the decisions ourselves. It is important, then, that we understand that we have our work cut out for us. We have tremendous things that we must be working on, and this conference is a real acknowledgement that we are on the cutting edge of change and that you are helping us by bringing this group together. I think it is most important that we do so.

It is not just how much we change the graduation requirements, but what we teach in those classes that is going to be critical. We must find ways of evaluating the classes that we teach so that we will know whether or not those classes will have in them the kinds of things that students ought to learn if they are going to be prepared for the 21st century.

I believe that we must have a way of weeding in and weeding out the teachers. We must weed in those that are good, those that are competent, and we must find a way to weed out those that are not. We can do that and not feel guilty. We must look once again at the whole tenure system. I grew up in an era when if you didn't have tenure you felt there was no security, and that's fine. I think we need some form of security. I don't think people ought to be treated unfairly. There must be due process. My friends, we cannot afford an educational system that retains

mediocrity in the classroom, or in the principal's office, or the superintendent's office, or anywhere along the line. We simply must change the way we review and evaluate our personnel. It is a critical thing that we must do. We must also recognize that people are going to continue to expect more. Whenever this country is in trouble, it is going to turn to the schools. Unless we are ready to solve those problems, unless we recognize how important education is, we will not be ready for all of the kinds of changes that occur.

Let me talk a minute about money, because there is a great deal of discussion today about the fact that public education is too expensive. Of course, it's expensive. It is a major industry in this country. Why do you think we're very popular with all the publishers and Tandy Corporation and everything? We're money. We don't have enough, but we have money. It is really a bargain if you compare it with other costly enterprises. If you consider the cost of unemployment, if you consider the cost of prisons, if you consider the cost of welfare, if you consider the cost of a life that is non-productive that we pay for, education is a real bargain. Somehow we have to get that point across so that the elected officials are not going around saying it's too expensive because, you know, if they think education is too expensive, just try ignorance. It's very expensive.

One of the most important things, I believe, that we can do as education leaders — and I think particularly those of you who are directors of computer education, whether you are in computer-assisted education or whether you are in any other aspect — is to begin to quantify what you are doing. Of course, computers are expensive. They are expensive to make, so they have to be expensive to buy. They are coming

down in price, but if you will consider what that will do to prepare people to work in the future, you will come up with some very glaring statistics that could help sell the concept to school systems. I think it is critical that we do so. It is critical that we get school boards and superintendents to understand that. Even more important than the cost, it is critical that we get teachers to understand that it can be a valuable teaching aid. It can be a valuable aid and the teacher can master it. One of the reasons that we are so delighted with our training process with teachers, and we are very grateful to Tandy for that, is that it is going to help them feel secure. You can't pack classrooms full of computers and expect teachers to walk in and feel comfortable. Nobody would. I have one in my house, and I haven't worked it out yet, haven't sent one memo on it. I've got electronic mail and it is just like Greek to me, but I'm going to master it as soon as I get time to get some lessons. The point is that if you want students to learn something, teach the teachers. We have an obligation to do that.

We have got to help administrators to understand why it is important, as well. Many more of our youngsters will get computers at home, as many have now. We've got to know where they are when they come to school, so that we don't hold them back and so that we let them progress. I went into a classroom recently, and the teacher was very frustrated because half of her class had computers at home and she had not had computer instruction. So she was very frustrated. That reminds me of the way we used to keep the kids back on the same page in the book. We cannot afford that. We want them to stretch and go as far and as high as they can go. We've got to find ways quickly of helping teachers to feel comfortable with the wide variety of technologies. There is nothing more gratifying

than to walk into a school that is really with its technology. It just makes such a difference when the principal understands it, the teachers understand it, and they've had classes for parents. It is a tremendous asset. We can't do that without training and preparation, and that takes time. I just hope that we will really understand that this takes a great deal of time and we will be out front before the revolution passes us by. We will be in the doldrums when other countries pass us by. More importantly, our students will not be ready to compete in this world. The students that we educate today will live in any number of countries. They will not just use America as their home base. We've got to be prepared for them and help them prepare for it.

In the future, then, as I see it, we must do several things. As I mentioned earlier, we must expand our notion of basic skills. A foreign language has to be a part of that. We are the only country in the world where you can speak one language and be considered educated. The average person on the street in England and in all of the European countries speaks two or three languages. We know that the time to do that is when they are in school -- not when they can take a crash course.

The second thing I think we must do in education is to start very early. We want to demystify math, science, and all those so-called hard subjects. We must do that in preschool, in kindergarten, and at least in the first three grades, because that's the time that students understand and are curious and are excited about it. We have to have teachers feeling secure about it.

Thirdly, I would like to propose that we have an institute -- an annual institute in the summer, a technology institute for teachers. We

could do that regionally throughout this country, and all of the technological companies could get together and sponsor this. It would be cost effective because we would buy the equipment in our school systems. If the companies got together and trained the teachers in the summer, I think it would be cost effective. We could also kick in a little money ourselves. Wouldn't it be tremendous if we could say that the teachers of America were going to be trained in technology and the companies got together on this? I don't know if they get together on too many things, but that would be tremendous. I think it would help us do many of the things that we want to do later on. School systems could pick up on that. There is no doubt about it — we have got to have them in our classrooms. We have got to have them in our classrooms soon.

I had a visitor from Japan and he was saying that they have computers starting at the kindergarten level in all of the schools in one little city. I said, "What about the teachers?" He said it was mandatory and they have to come every day an hour early and stay every day an hour after school. Well, we are in a democracy and in a democracy we can't quite do that. I don't want to trade my democracy, but I surely would like to be an autocrat sometimes and say that we can do that, but we can't.

The important thing is that we must find other ways of doing it. I really believe that teachers will stay and get courses. We have any number of courses offered to our teachers, and they are very eager to get this information. In Chicago, we have a large computer-assisted instruction program. We have had it for years, but I'm very pleased that it has expanded now. It's really coming into its own. We don't talk much about it. But I wanted to tell the superintendent yesterday that we have

academic olympics too, but we have done a very good job of packaging it. You know that is really true of public education.

The good things we do we've not really shared. We've really not told our story very well, and that is part of why we are in such trouble in terms of confidence. The good things we do are not marketed because we are so busy doing that we don't think about the marketing. I think we need marketing experts in every school district whose job it is to take those things that we do and sell them. In our academic olympics, kids perform beautifully and they like that competition. I think it is important that we continue those kinds of programs.

We have an adopt-a-school program. I would daresay that most of the schools that have been adopted have to do with computers. We instituted a program last year -- you can see that I am very high on teachers -- a teacher-incentive program where they can write a one-page proposal and get $1,000. Their peers review it. I asked our staff what teachers really want. What are they asking for in these one page proposals? 80% of those proposals have to do with computers. There are others that have to do with the arts and what have you, but that tells you what is on the minds of the teachers. Principals can write and get $10,000 if they win. They send in their proposals, and what we are finding is that the teachers and the principals are combining their efforts so that they can get a lot more money. You go into the schools and see what they are doing. It tells me that there is a level of readiness for microcomputers and software.

I have one other suggestion, and that is that we involve teachers in the development of software. I talked to a group of teachers in a high school recently and I said, "What would you need to make your computers really function?" They had a number of good ideas. I'm ready to go out to find somebody to help them flush out those ideas. They have tremendous ideas about what they would need in order to develop the kind of software that would really make a difference with their students. These were teachers who were working with students that were underachieving. They were really frustrated because they weren't getting with it, but the students were intrigued with the computer. Whatever turns them on, let's use it. If computers are going to be the thing that you can teach reading, math, English, and science and all of those things, it is a tremendous instrument that we ought to maximize and utilize.

Finally, I want to say a couple of words about what we must do with our elected officials, and then I'm really through. I may have to run. Every state that I know of, with the possible exception of mine and a few others, keeps coming up with these reform packages. Here is what worries me about those reform packages. First of all, they are not developed by educators. Every time we have an initiative it seems to me that it comes from somebody other than us. Scientists make their own discoveries. Doctors carry out their medicine. You don't have someone else doing the engineer's work, but everybody is an expert on education. They know how it ought to be done. I'm telling you that some of these packages are pretty good. They have some good ideas. I don't know if they will work, but the point I want to make is that unless we get involved as educators and help design the reform measures for the future, we're going to be stuck with a lot of legislation that we can't really live with. It

is critical that educators in various states and various schools get together and determine what we really need to do. That takes being rather objective about yourself. That takes saying that this really doesn't work and we're going to have to solve the problem. It takes also being able to present your point of view and to justify your point of view to those who make decisions. We have so many reformers in Illinois. Every elected official is a reformer expert as long as it doesn't cost any money. We have to sell them on the idea that there are some things that won't cost money, but there are an awful lot of things that must be bought with money. It is important that educators be on the cutting edge of the reform movement.

My one big worry as we go through the 80s is that we will have the kinds of programs that won't make the kinds of difference that we think we ought to make in our school systems. I believe that sitting in this room there are enough people who could write reform packages that we could turn the whole system around. So I would ask you as you go back to your school districts even to spend some time with your superintendent, if you are not a superintendent, in talking about creating some reforms. I also believe we've got to bring the community with us. There is nothing like laying some reforms on somebody who doesn't want to be reformed, because you know that unless you have the parents with you and unless you have the teachers with you, the parents can go home and do their own thing and the teachers can close the door and teach the same old way. We cannot just have legislation growing like Topsy without people who understand and know what will make it work.

The bottom line for us has to be how the students are doing. Are they performing well? I believe that computers can help us eliminate this whole notion of educating functional illiterates. I really do believe that because I think this is another avenue. Books have surely turned them off. We already know that and some of the other things that we use have also turned them off. We've not really found, yet, how they can really perform. There is no magic. It's going to be hard work. I think we ought to try to utilize computers. Everything else has failed and we are graduating them and they can't read. They can't write. They can't think. So let's try some of these things. Let's also bring teachers together in our respective districts and see what ideas they have for reform. When I talk to my teachers in Chicago in groups of twenty, and we have twenty school districts, they tell me all kinds of bad things that are in the teachers' contract that I ought to get out. I tell them to talk to the union leader about that. What I am saying is that teachers really have valuable ideas that we ought to capture.

I think the challenge before us is to rededicate ourselves to involving our peers in the reform efforts of this country and to involve them in pursuing excellence and equity with a vigor, because the 21st century is just around the corner and, whether we like it or not, even without those aging drugs we are going to be here.

Thank you.

Pierre Duguet

Pierre Duguet is the director of the New Information Technologies and Education project of the Organization for Economic Cooperation and Development in Paris, France.

It is a great honor for the OECD, which I represent here, to give you an overview of our activities in this exciting and important area of technology and education. I would like to thank the University of Texas and particularly Tandy Corporation/Radio Shack, for giving us this opportunity.

First of all, as an introduction, let me say a few words about the OECD and about our Centre, the Centre for Educational Research and Innovation (CERI). The OECD is an international organization which groups together the US and Canada and all European countries, plus Scandinavia, Japan, Australia, and New Zealand. These 24 countries are characterized by their high level of economic development.

The OECD was set up in 1960 under a convention which provides that the OECD shall promote policies designed:

- To achieve the highest sustainable economic growth and employment and a rising standard of living in member countries, while maintaining financial stability, and thus contributing to the development of the world economy;

- To contribute to sound economic expansion in member as well as non-member countries in the process of economic development; and

- To contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The Centre for Educational Research and Innovation was created in 1968 to deal with the qualitative aspects of education. It is fair to say that the creation of CERI was related very much to the big student unrest at that time. Certainly everybody remembers the demonstrations on the Berkeley campus in 1964, and in Berlin, Paris, Tokyo and Mexico City and Columbia in 1967-68.

The main objectives of our Centre then are as follows:

- To promote and support the development of research activities in education and undertake such research activities where appropriate;

- To promote and support pilot experiments with a view to introducing and testing innovations in the educational system; and

- To promote the development of cooperation between member countries in the field of educational research and innovation.

The issue of education and technology was, with other research on interdisciplinarity in higher education, curriculum development and recurrent education - one with which we started in 1968 and which in turn led us to organize a first international seminar in France in 1970. This Seminar was concerned with the introduction of computer sciences in secondary education and the ways of removing the aura of mystery surrounding the powers of the new facilities and mastering the possibilities they offered. One of the main debates focused on a question which is still under discussion in many countries: should computer science be taught as a separate discipline (we were not referring to the specific training of computer scientists) or should it be taught through the use of computers as an aid for learning in various disciplines? Fourteen years later the debate is still the same, and it is probably a false one. But at the same time, interest was beginning to be shown in many OECD countries regarding the possibility of using the computer as an educational tool. Indeed the American federal government has been financing research into computer assisted teaching since 1965, while the French government began to introduce computers in state secondary schools in 1970; and the Japanese government has been involved in this area of research since 1968. Moreover, in 1969 the United Kingdom National Council for Educational Technology submitted to the government a 5-year plan that was approved in 1972 and was designed to coordinate individual initiatives in the field of computer assisted teaching.

In order to ascertain the progress made in this field, in December, 1973, CERI organized an International Workshop in Edinburgh in the United Kingdom, which looked at the use of the computer in teaching secondary school subjects. Its recommendations were built around a precise criterion:

> "The computer should be used within the teaching/learning system only for tasks that either it alone can fulfill or that it can carry out markedly better than any other resource, all within the limitation of economic possibilities... computer-assisted instruction and/or drill and practice is at the moment inappropriate at school level, mainly because of costs..."

We all know that with the appearance of the microprocessor this recommendation is no longer valid, because costs have dropped dramatically, and that the technological revolution which is affecting so radically the organization and productivity of various socio-economic sectors will also affect the education sector.

The education sector in the OECD member countries is confronted with many forces and pressures from NIT, an acronym for "New Information Technologies."

1. First of all, one must consider the impact of the advertising campaigns by commercial firms, the vendors of microcomputers, and the

publishers of courseware. Obviously these Madison Avenue strategies are not reserved exclusively for the educational environment. Children and adults outside the educational system are made aware of the latest technological creations, such as home microcomputers, video games, pocket calculators, video recorders, etc., through the media. Incidentially, some people make the comparison between the introduction of audio-visual means these last two decades and observe that this has been more or less a failure. Maybe the main distinction between these audio-visual facilities and the NIT is that the former belonged to what could be called "the world of culture or communication" and the NIT to "the world of production." We have already a good example of this phenomenon with the pocket calculators which have been introduced widely in schools only because they were largely available on the market.

2. In addition, there is pressure from governments such the UK and France, where the Ministers of Education, Industry, and Post and Telecommunications are adopting concerted policies and actions to increase the amount of nationally made computers and telecommunications hardware used in schools. With the aid of new information technologies, this has the dual purpose of stimulating the economy while at the same time instructing students in their use.

3. Third, in many countries a shortage exists of qualified computer scientists; therefore schools and universities must respond to this new demand from the economy.

4. Finally, one must consider the influence of enthusiastic teachers, independently motivated pupils, certain parents' associations and the mass media. These diverse groups then exert their "cultural" pressure on our day-to-day life.

Therefore, the combination of these factors confront the educational system with an important challenge: how to assimilate and manage the change so as still contribute to the achievement of educational objectives. In other words, how to maximize the advantages and minimize the disadvantages of what is regarded as an inevitable development. Many advantages from NIT could be mainly related to their new and considerable interactive capability. That was not the case for the audio-visual facilities. Nevertheless, we know little about the real efficiency of these new technologies in the teaching/learning process; but it seems that they provide more opportunities than risks. They already create a dynamic which, in many countries, puts in question the traditional teaching methods and curricula — a dynamic which could help to solve the current crisis facing schools.

Given that background, we have divided our work into two phases. The first one is mainly concerned with information about the various policies in OECD countries, clarification of main issues and evaluation of the impact of NIT on the educational system. This first two-year phase will end with an International Conference to be held at the OECD in Paris this July. A second two-year phase (1985-86) will be essentially devoted

to activities in a number of specific research and development areas. The three main dimensions of our present work are information, clarification and perspective.

I. Information: The policy trends and developments in member countries.

Last year we undertook a survey, by means of a questionnaire submitted to the education authorities in member countries. The following are the main conclusions which emerged from our analysis:

1. By early 1983, virtually all OECD countries had engaged in policy and development actions aiming at introducing NIT in education and the trend towards accelerating this movement. For example, two countries which had no clear plans in 1983 have now published White Papers on the required developments: In January 1984, with their White Paper entitled "Informatics Stimulation Plan", The Netherlands presented their policy for 1984-88; Norway followed suit in February 1984, outlining in its White Paper the policies for introduction of NIT in primary, lower (elementary) and upper (secondary).

2. However, there are still important differences between countries or states of federal governments concerning their policies and their strategies of implementation.

We have tried to classify the country policies into a detailed taxonomy. Let me just indicate the two main approaches:

a) The comprehensive approach

Some countries have developed coordinated policies for the next coming years regarding equipment, software development, teacher training, computer literacy, and computer science. These coordinated policies aim at introducing NIT simultaneously at the various levels of education: elementary, secondary, vocational, higher education, and adult education. Furthermore, coordination exists between the various Ministers of Education, Industry, and Post and Telecommunications and others.

The most telling examples are those developed in France and the United Kingdom. It is particularly interesting because these two countries have different educational systems: highly centralized in France, while decentralized in the UK (where 125 local education authorities are in charge of education). One can also find such a comprehensive approach in some states or provinces, such as Ontario in Canada.

b) There are the vocational and curriculum approaches

The demand for specialized manpower has been the entry point of NIT in some countries where mainly the vocational sector has been concerned. Examples of this can be found in Japan, Austria, or Finland.

In parallel, computer science as a discipline for all has been introduced at the upper secondary level. This is the case for Switzerland, Spain, some Canadian provinces, and Denmark.

3. Strategies of implementation -- A variety of situations were identified, from the grass roots developments found in Italy, where the initiative comes from local authorities, schools, or individuals, to nationally coordinated plans. These exist in very few countries, for example in France, the UK, and in a few other countries.

In a report prepared for us by Professor Hess of Stanford University, he stressed that this "grass roots" movement was very common in the United States. Sometimes the enthusiasm of individual teachers and parents with the financial assistance of federal grants, had been sufficient in introducing computers to schools. This initial grass roots movement, however, is now being combined with more coherent policies at the local and national level.

We reached many interesting conclusions in our analysis, but there is one which deserves particular attention. In spite of the efforts made in several countries, we are far from achieving what could be called the "critical mass," that is the optimum level of equipment, qualified teachers, and good software necessary for computer literacy for all. One need only compare the availability of hardware in schools in a number of countries to see that more equipment is needed before this "critical mass"

can be achieved. In Scotland, one micro per school contrasts to England with around three; Japan has between one and four, depending on the level of education. A recent survey from the Department of Education and Science and the Schools Broadcasting Council indicates that every secondary school and a third of all primary schools in the United Kingdom now have a microcomputer, but this still means that there is only one microcomputer for every 200 pupils. Put another way, students can have access to the computer an average of one and a half minutes per day.

The growth of micros in the US schools has been dramatic, but in 1983 only 68 percent of the schools were equipped with from one to five micros. Comparing the 325,000 micros to the 40 million students indicates that the time spent on using micros is extremely limited. Arthur Melmed from the Department of Education has made the calculation that by 1988, if the equipment available doubled annually, each student would still only have ten minutes of computer time per day. The same situation applies to France, where the computer plan foresees 100,000 micros in 1988 (and, incidentally, 100,000 trained teachers). For the estimated 12 million students, the average on-line experience will be around three minutes per student per day.

Obviously this does not take into account other probable developments like more families having home computers or videotex terminals, nor the fact that the distribution of microcomputers will not be shared equally at the various education levels, the upper secondary and vocational receiving the bulk of the hardware in many countries.

II. Clarification: The major issues

Among the issues we attempted to clarify are the following:

i) The software/couseware problem;

ii) The cost/efficiency of NIT; and

iii) Computer literacy for all.

i) Let us examine the first problem, the software/courseware issue. It is clear that for the time being, courseware is generally of poor quality, as Secretary Bell noted in his address to Congress last year. Furthermore, the lack of compatibility between hardware creates in some countries enormous problems and prevents commercial software designers from investing heavily in programs because they could be sold only to schools using a particular make of computer. In 1982, the US market for conventional teaching materials such as textbooks and visual aids was $1 billion, as compared to the $28 million for computer courseware.

Some countries, such as France and the UK, have solved the problem by requiring schools to use only (or mainly) computers manufactured nationally and compatible together. (France prescribes also a specific programming language in French). The UK still encounters some problems of software transportability.

In their recent White Paper, the Norwegians indicate that free choice of equipment has led to the fact that today there are roughly 50 different types of computers in Norwegian schools and that the number of different operating systems is of the same magnitude. In comparison, the United Kingdom has three main micros in schools for a population 15 times greater than in Norway.

We must therefore ensure compatibility and produce high quality software at reasonable costs, but many problems remain regarding the creation and the diffusion of such courseware. Who should write the courseware? Some people say the teachers, after a specific training, while others argue that computer scientists should do it after preparatory interdisciplinary work involving various teachers and cognitive psychologists. Others are thinking about very high-level authoring languages, thus permitting untrained teachers to write their own courseware. This is the case in France.

We have tried in our report to discuss such issues, including the critical problems involving copyrights. Maybe one of the most important conclusions is that we should create courseware adaptable not only for today's machines, but also for systems that will be typical five years or a decade from now.

ii) Next we need to clarify the cost efficiency issue of NIT.

Public expenditure on education has multiplied several times since the sixties, and, as we know, teachers' salaries represent the bulk of this expenditure. Therefore, if we start from the principle that the quality of education depends mainly on optimum teacher/pupil ratios, there is no reason why education costs should stabilize.

During the first NIT development phase in various socio-economic sectors, overall costs may increase, but in a second phase productivity has increased. The same may be true in education where NIT could lower the teacher/pupil ratios by avoiding an increase in the numbers of teachers greater in proportion than the increase in pupils and by improving the "teacher productivity," the teachers having available free time to devise and evaluate more efficient training/learning strategies.

Our conclusion is that NIT have considerable potential to improve the school's efficiency. Nevertheless, it is very difficult now to assess this potential which is linked to the achievement of this "critical mass," that is, the interrelationship of equipment, the creation and diffusion of quality software, and teacher training.

iii) Computer literacy for all

This is a major issue for obvious reasons, but sometimes these reasons may not be so obvious. In most OECD countries, there is considerable effort by the government to make people literate. This can be

seen in your own country by the direct involvement of Secretary Bell, and in France, where last fall President Francois Mitterand, accompanied by six various ministers (education, industry and research, post and telecommunications, etc.), held a seminar on this subject.

In our research we have tried to analyze experiments conducted by various institutions, enterprises, unions, museums, fairs, holiday centres, local authorities and schools and universities. We were mainly concerned with adults as the target group. Not surprisingly they expressed more fear vis-à-vis NIT than did children.

One of our conclusions, then, is that schools and universities are lagging behond other private and public non-educational institutions in this field. To give an example, one of the largest holiday organizations, Club Mediterranée, initiated 100,000 adults in the use of computers last year! Schools should certainly increase their role in preparing students for this new technological society and universities should incorporate critical function vis-à-vis the curriculum.

III. Our third concern was an evaluation of the possible impact of NIT on the functioning of education

On the assumption of mass NIT development (which is why I said "possible" impact), unprecedented changes could affect the functioning of the school and university.

1. First of all, the learning process could be changed. School children at a much earlier age could acquire certain logical structures and formal and conceptual skills currently developed only at later school ages. This has been well described by Seymour Papert in his discussion of the classical Piagetian sequences of learning. But it is also likely that the children would learn different skills (and maybe lose some of the traditional ones) and build different knowledge systems. In our report, we have tried to clarify the impact of the new information technologies (mainly computers) on learning processes in formal education. We have analyzed in particular how the most recent wave of research on learning translates in possible pedagogical approaches and how these, in turn, could be integrated in mass education.

One of the main conclusions is of many promises as well as many uncertainties. NIT have an impact on learning, although not much is yet known as to the specific nature of such an impact. Evidence also exists as to the important pedagogical implications of such a possible impact — in particular on the importance of autonomous learning, personal exploration, and discovery. It remains to be seen how the institution of education could accommodate these pedagogical approaches without undergoing a profound institutional change.

2. Second NIT could have important impacts on the curricula.

Curricula could be radically remodeled in certain disciplines as

they could be based more on methodological approaches (such as "learning to learn") and less on the acquisition of facts or information more easily accessed via NIT both in schools and in adult life. Not only the content of disciplines could be changed, but new interdisciplinary subjects might be created.

As I said at the beginning, NIT are already creating a dynamic which permits us to rethink and restructure the curricula — an extremely important point.

Where do we stand now? We have conducted a number of case-studies in various countries, on educational institutions which have been using NIT for some years. These studies have been conducted in the US, the United Kingdom, Canada, Australia, Japan, The Netherlands, Denmark, Belgium, and New Zealand. The most extensive of these studies has been conducted in the US under the direction of Professor Nolan Estes.

I think that two main conclusions emerge from the general analysis:

i) In most cases, there has been an extension of the curriculum by adding a new subject — computer science or computer literacy courses — with no significant impact on the traditional subjects. Nevertheless, there are a few exceptions: for example, the teaching of handwriting skills at elementary level with the help of word processors or the necessary changes of some of the curricula for technical and vocational education.

ii) But most of the authors of the case-studies indicate that, in their opinion, NIT will affect the cirriculum, but that it is too early to predict, given the present dearth of software and equipment, what the final impact will be. In addition, these case-studies predict that the structural organization of educational institutions is likely to be overturned as a result of the interactive approach offered by NIT. Pupils will be able to progress at their own pace, with some advancing more rapidly than others if use is made of other educational settings: for example science museums and home computers. For the time being, distance learning via NIT is developing considerably, particularly in North America and Australia.

3. The third possible impact of NIT concerns the teachers

Again, a number of case-studies have been conducted to clarify how the functions and role of teachers and other educational staff are diversified and altered by using NIT; to clarify the new skills that teachers need to acquire; and to clarify the implications for teacher training.

Professor Estes reported in his study in the US that:

> "Generally, teaching functions have not changed, except in the sense that teachers who are now designated to teach computer literacy, awareness, or science must learn a new discipline or content area. One district, which requires all teachers to pass a certificate test, expects all teachers to demonstrate new competencies in this area. In the districts which train teachers to become trainers themselves or resource persons at their own schools, new functions are expected for those teachers. But the average classroom teacher is not teaching in a new or different way as a result of technology."[82]

Our analytical report based on the various studies reached similar conclusions, but one can see that:

i) There is clearly a discernible set of functions which are emerging for the new NIT teacher coordinators.

ii) The teacher needs to acquire an understanding of the different capabilities of NITs.

iii) Since teachers are engaged in the process, they have to face software problems such as the selection of it or creation of some of it.

iv) But by and large, the impact of NIT on the teacher's functions is intriguingly difficult to predict.

In this third part of our work, i.e., the impact of NIT on education, we are loath to draw any conclusions. For this reason, it is clear that more research is needed on the potential educational uses of NIT. In conclusion, I will make a few remarks on the work we have undertaken in this area.

R & D in the advanced educational applications of NIT

As a first step, the idea was to gather factual information on groups and institutions engaged in research and on the level of activity

expressed in terms of either level of funding or man-years of effort committed in order to map the present pattern of research and to identify:

— Areas where there are sufficiently active groups in member countries to make an international cooperation program possible; and

— Areas where there is need for an enhanced research effort.

Therefore, a questionnaire was sent to various research institutions in the US, Canada, France, Sweden, the UK, and Japan. I am unable to elaborate on specific points until the analysis is complete, but some very interesting trends are indicated:

i) It appears clear that the level of research and development is generally low compared to the importance of this technological evolution for education.

ii) Some governments are aware of this fact and therefore are either providing more facilities to the existing research centres, or are creating new centres which group together the various necessary specialists in pluridisciplinary teams (for example, teachers or specialists of artificial intelligence, and computer scientists). This is certainly the case in your country, the UK, Australia, and France.

iii) Finally, there are a number of opportunities to develop international research networks. Obviously, the OECD as an international body will encourage and facilitate this cooperation.

Following the July International Conference, our Centre will follow some of the issues I have mentioned. Work will continue, obviously, on the R & D networks, but also, for example, on the impact of NIT on learning processes and curriculum development with a focus on basic skills and on evaluation and quality. But we will also tackle other issues, particularly the one concerning equality vis-à-vis NIT. Despite considerable concern in some countries, such as your country and France, over issues of equity and equal opportunity, it seems apparent that there is differential usage and access to computer training for students from different ethnic groups and socio-economic levels as well as girls and boys. Generally, these differences in the schools are paralleled by differences in availability of computers at home, giving children from affluent backgrounds two advantages: they have access to equipment at school, and after school they continue to use NIT at home.

This issue will require a great deal of our attention in the future.

From Slates to Silicon

Dr. Patricia Albjerg Graham

Dr. Graham is the Dean of the Harvard University Graduate School of Education.

"From Slates to Silicon" Why such a title for a talk? The central idea is that throughout their history educators have been faced with new technologies intended to improve children's learning. These new technologies have often changed what we believed children needed to know, usually expanding the amount to be covered in the curriculum, have invariably been more expensive initially than previous means of instruction, and frequently have been resisted by the teachers who were supposed to use them. The present interest in microcomputers and other new technologies to be used for educational purposes fits into this historical chain.

The history of education is filled with an unending parade of new technologies: slates, books, paper notebooks, pencils and eventually even non-leaky pens, blackboards, workbooks, slide rules, mimeograph and ditto machines, radio and film, television, and now the silicon chip computers. Hence the title, "From Slates to Silicon." Each of these new materials of instruction allowed children either to become acquainted with larger bodies of knowledge (as those presented in books, radio, film, or television) or to manipulate new material more easily (as paper notebooks, pencils, pens

and workbooks did). The promise of the new interactive technologies for education is that they will both present new material to students and permit them to manipulate it more easily as well. That promise is a very important, challenging one, but like all promises, it is still a hope, not a reality.

One key characteristic of schooling in America and elsewhere until well into this century was the emphasis upon rote work, of memorization of material. Educators believed firmly in the value of this pedagogy both for its intrinsic theoretical merit and for its immensely practical value. It required few resources, only a book for the teacher to use in drilling the students. In classrooms that were chronically short of materials, as rural school rooms traditionally were, and as many of the new overcrowded city schools serving immigrant children were also at the turn of the century, memory work was justified as a cheap means of providing the mind with both useful information (such as the multiplication tables) or beneficial knowledge (such as the poems of Alfred Lord Tennyson or Henry Wadsworth Longfellow). The theoretical justification for this intensely practical activity was called the theory of mentaldiscipline. According to its proponents, the mind could best be thought of as a muscle, which benefitted from rigorous excercise to achieve maximum performance. Such exercise as that resulting from memorization kept the mind in trim. Throughout much of the nineteenth century the leading document expressing justification for education was the Yale Report, published in 1828. Although its views were not the determining ones for university education, it had a profound effect upon pre-collegiate curriculum, as colleges frequently have had. The Yale

Report argued vigorously for nurturing both the discipline and the furniture, explaining, "The two great points to be gained in intellectual culture, are the DISCIPLINE and the FURNITURE of the mind; expanding its powers, and storing it with knowledge. The former of these is, perhaps, the more important of the two. A commanding object, therefore, in a collegiate course, should be, to call into daily and vigorous exercise the faculties of the student."

Thus, the Yale Report, drafted as it was to guide undergraduate instruction, influenced several generations of school people, encouraging them to continue a practice emphasizing memory and rote work, a happy coincidence of theory and practicality pointing toward a common solution. In such cases it is often difficult to know whether the practicality drove the theory or whether the two were independent of each other.

The shift of the educators' preeminent concern from disciplining the mind to furnishing it was expensive. Exercising the mind, as it had traditionally been conceived, was much cheaper than providing it with new information, as now appeared to be desirable. For example, if one believed that an educated person was one who was familiar with the classics, a view that persisted well into the twentieth century, then the curriculum materials and the books required for providing that instruction were limited. Harvard, in its wisdom, could offer a five foot shelf that was intended to provide a library sufficient to support an educated person. In the middle years of the twentieth century encyclopedias regularly were sold

to ambitious families who were told that in the 20 volumes of the World Book or the 20 volumes of the Book of Knowledge resided all the information that a modern child would need. Less affluent parents settled for the two-volume Lincoln Libraries, convinced (and probably correctly) that two volumes were better than none.

During the last thirty years we have significantly moved from the notion that we expected children to know could be codified easily in a few volumes. Textbooks are questioned. We prefer reading lists, evidence that we have rejected the notion that knowledge can be neatly codified.

In the high schools and elementary schools, we no longer even have libraries. Rather, we have media centers, recognizing that much of the information that we expect children to acquire in school will come from a variety of sources, not just from books and periodicals. These changes vastly enhance the opportunities for children to learn. The contrast between a school which has a library stocked principally by discards from the local methodist church and the remnants of the local tycoon's personal library and one with a full-fledged media center will not assure student learning, it certainly will not hamper it. But such a media center is profoundly more expensive than a tiny library. In this country - and all others with which I am familiar - the privileged in the society are much more likely to have access to the expensive site than are those who are not privileged.

Traditionally many public schools, most parochial schools, and some private schools have been short of funds. Since most school budgets have shown well over 85 percent of their funds expended for personnel costs, the amount remaining for materials has been very limited, often no more than 1 percent of the budget. In districts that do not have affluent clienteles, the amount for materials has been even less, and, of course, in those communities, the children usually have fewer educational materials at home. In the nineteenth century the cost of serious books was prohibitive (and some believe it has become so again today!), but book costs dropped dramatically in the early years of the twentieth century, and books became common items in schools, which they were not one hundred years earlier. With expanded library collections, with laboratories for science instruction, with art and music rooms for aesthetic explorations, with media collections of films, radio and television programs the curriculum could be vastly enriched. The child whose previous explorations were limited to the print and colored plates of The Book of Knowledge now has immensely broader fields to conquer.

The influx of new instructional materials during the past fifty years has profoundly changed the curriculum, thereby broadening the gap between what is taught in affluent and in poor schools. At the time when the primary school curriculum was largely limited to memorizing the alphabet, number facts, multiplication and division tables, spelling words, and learning to read through the McGuffey series, the budget for primary school curriculum materials was very modest. Today the range of materials

available to enhance learning and to expand children's experiences through vicarious learning of various sorts is immense, and one primary factor governs whether those broader resources will be available to the children. That factor is cost. In the late fifties the issue might have been whether a teacher could afford to buy with school funds SRA Reading Boxes to provide individualized reading instruction for students with different reading achievements. Two such reading boxes would serve a class of 25, and in 1960 two such boxes, which with care might last five or six years, would have cost less than $50 each. Today such a reading box costs $250. But today if we are going to take account of the new and improved microcomputers to teach reading, we might need five machines at approximately $300 each with software for them costing $500 apiece. A summer 1983 survey by the Massachusetts Department of Education estimated that currently in that high tech state the ratio of "keyboards" to students is 1 to 93. Reading scores of minority children and children of the poor nationally are on an average lower than those of affluent children, yet it is the schools and school districts of these children, who are on average reading better, that are currently more likely to have such enhancements to learning, largely as a consequence of the cost. By the mid-twentieth century all schools knew that they must invest in instructional materials, beginning with books but enlarging their collections beyond them. Most were beginning to understand that other tools of instruction were important as well. Schools of education began requiring study of "audio-visual aids" for future teachers yet these AV courses, as they were often derisively called, were most appropriate for those teachers headed for affluent districts. When I began teaching in Deep Creek, Virginia in 1955, (a

system serving the white children living in the Dismal Swamp - definitely the children of the poor) all my tests were written on the blackboard because as a beginning teacher (and therefore with little clout in the school) I did not have access to the one mimeograph machine, that school's sole AV device. Two years later when I got to Norfolk, Virginia, a city system, I could use both mimeo and ditto machines. In New York City in the late sixties and the early seventies, the school closets were filled with overhead projectors and other ingenious devices, often purchased with federal funds, that teachers chose not to use.

The question persists: why, when new materials and new tools of instruction are available, have teachers been reluctant to use them? Larry Cuban has written persuasively about this phenomenon, which he terms, "Persistence of the Inevitable: The Teacher-Centered Classroom" (Education and Urban Society, November, 1982, pp.26-41). In an extensive review of the recent reports and books on education in the New York Review of Books, Andrew Hacker remarks on the fundamental conservatism of schooling (commenting on the accounts in John Goodlad's recent volume, A Place Called School), "In its essentials, education has not changed since it moved indoors" ("On Flunking School,"NYRB, 4/12/84, p.36). Despite the a-v courses, the teachers institutes sponsored by the NDEA and NSF funds, the continued criticism by the American public of schooling, teachers have persisted in the practices in which they have engaged for many years. This has been particularly true for secondary teachers, and particularly unfortunate since they are the ones who have faced the greatest gap between

what their pupils are supposed to know and what they actually know. Elementary teachers have faced a narrower gap between expectations and reality (a third grade child is by definition not going to be four years behind grade level) than secondary teachers. Elementary teachers have often been more responsive to innovative pedagogical practices since both their academic preparation and the ethos of their working environment has stressed the overall development of their students while secondary teacher have been prepared to be "subject matter specialists" and have been under the illusion that their students had mastered the previous material in the curriculum.

As Cuban, Hacker and others point out, there are a variety of explanations for the reluctance of teachers to adopt new pedagogical strategies and to utilize the new materials available to them. For me, however, the most fundamental reason that teachers have not done so is that most teachers have not perceived their student's mastery of academic material as their primary responsibility. Teachers are fond of giving various justifications - often accurate - of pupils' poor performance. Teachers traditionally have not assumed responsibility for the academic learning of all their students. They have not believed, nor have they been pushed by the administration or the community to believe, that their principal task was to be sure that EVERY student learned in their class. Such expectations are now growing in this country, and if they become widely accepted, then teachers will face very different tasks than they have in the past. If so, then they will be looking ever more vigorously

for means of enhancing their pedagogical effectiveness so that their students will demonstrate mastery of the material being taught.

New instructional materials have brought great promise for broadening and deepening the curriculum, for introducing children to new ideas, for helping children master the curriculum more easily. These new technologies have introduced new ideas and aided children in manipulating the new data. But in addition to the opportunities they have presented, they have brought with them two important complications: first, they have been expensive and, therefore, often not available to schools with profound educational needs and second, even when they were available, many teachers have not used them. Both have been formidable difficulties.

Let us now turn to the microcomputer as an exemplar of the new, interactive technologies being explored for educational uses. Does it seem to fit into this panorama of innovation of educational materials? I would argue that it does fit. The microcomputer provides the opportunity of vastly enhancing the curriculum and of aiding the student in learning the material and skills being presented. Its promise is of both expanding students' knowledge and of deepening their understanding of academic subjects and of the skills of writing, computing, and reading. That is a magnificent promise. Microcomputers also face the two problems alluded to earlier: (1) The machines cost, but even more important than the cost of the machines, which is falling, is the enormous expense of developing appropriate software for use on the machines. That is truly expensive,

both in dollars themselves and in intellectual resources required to prepare really valuable software. Without such intrinsically interesting and provocative software, the machines will come to litter the school closets as overhead projectors have done for two decades. (2) Teachers must come to believe in the capacity of the microcomputer and their software to assist them in a basic way. For the new technologies to be helpful to teachers in a fundamental way, teachers must arrive at two new understandings: they must believe their primary task is to make all children learn and the new technologies must be able to help all children achieve that goal. If teachers accepted the responsibility for enhancing the learning of all children, then they would be eager to utilize tools to enable them to achieve that goal. Under such circumstances resistance to the technologies would fade. Without acceptance of that responsibility traditional patterns of reluctance to change would prevail.

Another caveat has been raised about the use of microcomputers in education, particularly by J. David Bolter in his recent book, Turing's Man, Western Culture in the Computer Age. Bolter argues, convincingly, that computers help one enormously to rationalize issues, to analyze. As Bolter puts it, "Turing's man analyzes not primarily to understand but to act...knowledge is a process, a skill. A man or a computer knows something only if he or it can produce the right answer when asked the right question. Theapproach to any problem is still highly analytical but utterly superficial...all complexity is drained from a problem, and mystery and depth vanish, defined out of existence by the programmer's operational

cast of thought" (p.222). For us in education we want our children to learn, and for most of us that means not only the ability to act, to get the right answer, but much more importantly to understand, to learn how to ask the right question, and to accept the mystery of life with the noncommitant impulse to explore that mystery through understanding and asking of the right questions. Bolter's concern about educational manifestations of computers is an appropriate one, but since we are not at the moment facing a curriculum entirely dominated by computer learning, it is a caution for us to consider. Currently there is great need for most students to improve their capacities for analysis and for action based on analysis. For those tasks the computers promise considerable assistance.

At the Harvard Graduate School of Education we have recently established, under a contract of the National Institute of Education under the Department of Education, an Educational Technology Center under the joint leadership of Gregory Jackson and Judah Schwartz. This center complements other work at Harvard on technology and education, including that of Gerald Lesser and his colleagues on children's television; Colette Daiute, Sarah Michaels and their co-workers on teaching writing through word processing; and Courtney Cazden, Jeanne Chall, and Carol Chomsky on language development and reading. Three principles underlie the Center's work: (1) Technology, like other pedagogical tools, can reflect a range of pedagogical philosophies; discussion of teaching philosophy is therefore important to the design and application of software; (2) Research on educational technology must proceed in the context of subject matter to be

learned, rather than focus exclusively on the "process" of learning; and (3) If research is to be useful in practice, it must be guided from its inception by practitioners as well as traditional researchers. In sum, we believe that three factors need to be taken into account when working in the field of educational technology: the child and the child's attributes of cognitive development, the academic subject matter that is to be learned and its structure, and the teacher who is expected in some undefined way to unite the child cognitively with the subject matter.

Our assumption is that, as Jerrold Zacharias has often observed, 80 percent of the children are overlooked in most schools. The top 10 percent and the bottom 10 percent receive a good deal of attention, but the middle 80 percent are frequently ignored. The hope of the new technology is that these middle 80 will benefit substantially from our efforts. Our stratey has been to identify what we call "targets of difficulty" and concentrate our collective attention upon them. "Targets of difficulty" are places which teachers identify as locations in the curriculum at which a substantial number of children will have difficulty mastering the material. Our effort is then to concentrate upon those targets and attempt to devise means by which a teacher can ease a child's passage through such locales. For example, we are beginning work on the concepts of weight and density in the science curriculum and the topics of word problems and fractions and decimals in mathematics.

As you can infer from my remarks, our efforts are upon using the

new technology of the computer to enhance students' learning of traditional subject matter. Despite the considerable chatter about computer literacy, we have been less concerned about courses in computer literacy and more concerned about ways that a student and a teacher can learn to use a computer to enhance learning in a variety of areas, not just about computers themselves.

We suspect, although clearly we cannot be sure, that our engagement with computers at the moment is a bit like our ancestors' engagements with automobiles sixty or seventy years ago. Initially to the horse and buggy consumer, the automobile with its mysterious internal combustion engine, its myriad of cranks, sparks, and levers was an ingenious, endlessly intriguing device whose attraction was both intrinsic for its own novelty and complexity and extrinsic for its capacity to transport one further and more comfortably than the old nag. In the intervening years we have seen automobiles become immensely more mechanically and electronically complex, and we are also substantially less interested in the intrinsic question of how they work and much more interested in the extrinsic question of their reliability, cost, and performance. I would suggest tentatively that much of the current focus upon computer literacy is comparable to the attention given to automobiles around World War I. In the future most of us will not be interested in building computers from scratch nor even primarily in programming them. We will be very concerned, however, about the utility of the computer in assisting us educationally. Our attention will focus upon the computer's reliability, cost and performance for us in education. On those grounds I am cautiously optimistic about the future.

PART III

BREAKOUT SESSIONS

COMPUTER LITERACY AT THE SECONDARY LEVEL

By: Dr. Arthur Luehrmann

Dr. Luehrmann is a renegade physicist who coined the phrase "computer literacy." His academic posts range from Dartmouth to UC Berkeley. Arthur Luehrmann's influence is strongly felt through his projects, his publications, and his advisory boards including Electronic Learning and the NAEP or National Assessment of Educational Progress.

Let's review what's happened with educational computing in schools over the last ten years, and then what's going on right now. We'll look at that in some close detail because what's going on is complex. Trying to figure out what's going on is like the proverbial blind man deciding what an elephant is. Many people have information, but they all have information at different levels and places in the system and it's kind of hard to integrate it somehow and see what the big picture is. Elephants are easier, actually, because they stay put more or less, unless they get electrocuted in Louisiana, whereas this target we're talking about here is a moving target. It's moving very, very, very rapidly, and the data you collect in one year is very different from the data you're going to collect in another year. Some of the numbers, for instance, I'll be using from academic year '82-'83 — this is '83-'84 — and the numbers from that period are simply flat out wrong, at least as regards totals. But the distributions may be quite similar, nobody knows yet because the data hasn't been really well collected at this time. The point is, it is a

moving target. Many, many people in the educational community are making their own separate decisions about what to do about computer education. They are quite different from one another often. There are some common teams, and the process moves along as a result of all of these separate decisions. So, it's a picture that has some "iffiness" about it, but I think it will help to go over some of the facts that we know at least about what was true a year ago.

Educational computing started when computers began; people had to learn how to use them. Programming language was invented quite a bit after computers because people just didn't like to work with one's and zero's. And, so, a natural language was needed, a semi-natural language was needed to communicate with computers. Languages like Fortran and others were invented about that time and others. The systems that people had access to were very personal computers. They ran one job at a time. They did batch processing, a "batch" because the way to use the machine efficiently was to pile up a whole bunch of jobs punched on cards and put them in a card hopper and feed one in after the other. We tried to keep the machine busy because the machine was so terribly expensive that the worst thing you could possibly do was leave it doing nothing. Doing nothing was just a high cost activity. Batch processing is a very unfriendly environment for a person to work in because a person has to independently write a program on paper, carefully putting all the characters in the right columns. Then you go to the keypunch machine and punch the cards correctly, verify that the cards are punched correctly, then take those cards somewhere else and

put them through a window — typically, in a hole in the wall where some unknown person picks up the deck of cards and puts it in the card reader. Then in a good system after two hours, and a typical system a day later, one would get a pile of paper back that would tell the user that he had made quite a few mistakes typing. One would iterate on that until finally one got an answer. Then one would discover that the program was syntactically correct, the grammar was right and the spelling was right, but it didn't do what the programer wanted. So, proceed with rewriting — a very painful, unpleasant situation. Nevertheless, some early pioneers used batch processing systems to do educational computing activities. Most activity was at the college level, of course, in fact, at the graduate level. Then time-sharing came along around 1963-64-65, and it became possible for that expensive computer to be shared by many, many users at the same time, each one feeling as though he or she had a personal computer. This was before the time when personal computers were practical, but the user had the sense of being in control; being able to enter a program and immediately run it and see the output and get those grammar mistakes very, very quickly. The most famous educational time-sharing system was the one at Dartmouth College which came on-line about 1964. There was also one at MIT about the same time, and new languages appeared that were more suitable for ordinary mortals to use. BASIC appeared, and other languages started flowing after that. Pascal, incidentally, came very quickly after that in 1969-1970. People think of Pascal as a brand new language, but that is not true. It's an old language.

Many computers started appearing around 1970, and this is the first indication that the actual computer might be sitting in the same room with the user. The user might have a computer of his own. Then micros came along around 1977, and that brings us up to the trend that we're in right now. Schools, classes and now even individuals can easily plan if they had a use for a computer to own one.

Another way of looking at this time series is to look at the cost. Originally, in the old days when there were batch processing systems and early time-sharing systems, the amount of capital equipment that had to be behind that terminal — the terminal plus a share of the computer plus the communications back and forth — that equipment cost around $20,000. Now there's a big jump from '65 to '80 and you see that the cost per workstation, which is now per computer really with the personal computers, is going down to smaller and smaller numbers. It's easy for a school now to contract for a complete computer system with a disc drive and a monitor for under $1,000, and many schools are doing exactly that. They're getting good price breaks. The price is continuing to go down; it will continue to go down, by the way, but in a funny way. The price per computer won't go too much lower because ultimately the computer is a TV set, but the memory technology and the processor technology will continue this kind of expansile increases in power for given costs. But a TV set is a TV set; we've had decades of building TV sets, we're not going to learn how to do it much better than we know today. We're not going to learn how to do keyboard much better than we know how to do today. So, some components of

a computer are simply not going to get any cheaper than they are now. Other components will probably not really get much cheaper, but they'll get better and better such as more memory and faster processors.

How many computers do elementary schools have? How are they being used and who's using them? Henry J. Becker is a social scientist at John Hopkins data collection and very good high quality statistical analyses of data.

The media numbers per elementary school in 1982-83 was about close to two computers per school. How were they being used? About 18% of schools reported intensive use in teaching programming. Twenty-two percent reported intensive use in drill and practice, and the other uses were kind of smallish distributed over many different application areas. Who is using them? About a fifth of the students in the schools who have at least one computer were using the computer at least once a week.

Middle school includes upper elementary and junior high. In middle schools the number of computers is about twice as large or around three or four computers per middle school, but the usage pattern is a little bit different as well as the number of computers. About 32% of schools report intensive use in teaching programming which is the leader in terms of application areas and uses. Only 24% report use in drill and practice, and in the median school about an eighth of the students use the computer at least once a week. Fewer students are actually putting their

hands on a computer, but they're putting their hands on more computers for longer periods of time. And more frequently than not, what they're learning is how to take charge of the computer and make it do things themselves rather than learning math facts or spelling rules. In high school the trend continues more or less in the same direction so that in '82 and '83, the number of computers per school was about 5 or 6. I think it's close to double that right now. About 64% of high schools report intensive use in teaching programming, about two thirds. And about 11% report intensive use in drill and practice. There's a difference between those schools that aren't teaching programming and those schools that are teaching drill and practice. Inner-city schools, typically with large minority enrollments use the computer to do drill and practice. The opposite extreme, the suburban school in a fairly high income district, uses the computer primarily to teach mastery of skills in computing itself.

Who is using computers? In high schools, about one student in ten uses the computer at least once a week. Fewer students account for more concentrated use. By the way, that 10% figure is nothing to complain about. If you think about it a minute, many high schools have a typing course and enough typing machines and enough typing teacher talent to guarantee that every kid in school can learn to type. If you ask - if you just went into school and picked 10 kids at random and said, "Did you use a typewriter this week?" It would be about one in ten. A one to ten ratio can describe an instructional program that hits every single student in school. That's possible. So one in ten isn't a bad number on it's face.

Many, many states are moving along towards some kind of requirements in the general area of computer literacy although they do this differently. In some states they put the requirement on the student. Ultimately the schools are required to provide the skills to the student, but the requirement is that students demonstrate skills. Presumably coming behind that is going to be testing to find out whether or not the kids have the skills. On the other hand, other states put their requirement on the schools only but not on the students. Courses are mandated so students who want to participate in acquiring those skills can have an opportunity to do so. Or, a local school might decide on its own to make its own requirements that there be such, but the state would come in and say, "Thy school - thou shalt have a computer literacy course." The majority of states at this point are simply recommending that schools have courses. That's kind of the spectrum of activity and some states, such as Texas, have moved out of one column and into another.

Illiteracy is the report from the Department of Education that got everybody's attention a while back. The commission on excellence in education whose report was entitled "A Nation At Risk," recommends for all students as a graduation requirement, a half-year course in computer science. They don't even say computer literacy, they say computer science, which indicates that some people think that American students should take a subject that has rich content in computing and could even be called computer science.

There are other indications of the growing legitmacy of computer literacy as a school subject. I serve on an advisory group for the National Assessment of Educational Progress. This is a semi - bi-annual event in which a statistical sample of U.S. students is given test items to see what they're learning. That organization, NAEP, decided that there should be items in 1985's assessment on computer competency, the skills that one gets from using a computer. I should point out also that the group of advisors agreed that the dominant kind of test item ought to be one that depends on a student's having had some hands-on experience with a computer or with using software, and that only maybe one question in 20 should deal with book knowledge about computers, computers in society, facts about computers, etc. The dominant questions ought to allow the student to demonstrate that he has actually used a computer to solve a problem, to do some constructive work, and has learned the things that would go along with that. This committee is not made up of a bunch of computer science snobs with only one computer scientist on the task force. (I'm not a computer scientist, I'm a renegade physicist!) There was only one computer scientist on the task force primarily made up of school people, for example, the foreman from the Houston district. School people were grappling with the question of what we should be teaching kids in our schools. They felt that it was not worth examining kids on book knowledge about computers. It was passé. We did that in the old days because we just didn't have the equipment to do a hands-on course. But now as you can see from the data, any school can afford to have the necessary equipment to assure that every student has a hands-on course in computing just as they

can afford to have a hands-on course in typing for everybody. I find myself in the funny position of arguing for a little more of factual knowledge which I don't think is totally worthless. Committees, however, take votes.

Computer literacy has two components. One is knowing something about a computer, what it can do, what it's limitations are, what kinds of applications are possible. That's the minor part. The major part is being able to tell a computer what you want it to do, being able to use a computer to solve a problem. This implies linguistic skills, knowing a computer language, knowing the way to give instructions to a computer. If you want to tell a computer to do something, you have to give it instructions. To give instructions, you have to use a language. It's as simple as that. There's no way to tell a computer to do something unless you have language skills to use to do the telling.

Unfortunately there's a word associated with giving instructions to a computer and sometimes it causes hairs to rise on the back of some people's necks. It's called programming. Giving instructions to a computer is called programming. Don't worry about that and don't assume that we're somehow talking about preparing people for wonderful careers and jobs out there in this world that's going to be full of programmers. It seems to be that if the goal of computer literacy is to have students be able to use computers themselves, they're going to have to learn how to give instructions to the computers. That's all there is to it. Giving

instruction to a computer is called programming and fluent use of languages if we're talking to computers means programming languages. Fluent use of these languages is the very backbone of computer literacy. If you take that backbone out, the rest of the subject just collapses into a useless heap of facts and opinions about computers in society. The real content of a computer course of any value is the skills that students acquire in working with computers themselves which they can walk out of school with and use and not just a bunch of facts to remember until the quiz. Why is it worth doing this anyway? So far it's been an abstract definition. It's like geometry, you know, you can define everything the way you want and then you can prove theorems, but so what? Geometry would be pretty meaningless if you didn't believe that the triangles you learned about really had to do with things you could draw on the ground and had three sides. That's the whole point of an abstract definition. It's got to be nailed down to something real so that we can make meaning out of it.

Let me start out by dealing with two oft-cited reasons not to teach programming to anybody. One of these reasons is to train millions of programmers. The reason we should teach programming in school is that there are going to be jobs with millions of programmers and school had better get ready because they want to prepare their kids to go get all of these programming jobs that they're going to have to get because all the jobs are going to require some programming skills. That's just not true. It's probably not true that more than 2% of the work force, twenty years from now, will be professional programmers. So you shouldn't gear up an

academic program on the premise that basically you're preparing people who take this one semester to go out there and qualify for these super jobs in the computer industry. But, on the other hand, we teach an awful lot of writing in school. The writing curriculum is long and hard, and we work very hard on it. How many jobs do you think there are for professional writers? Fewer than programmers. There just are not that many jobs for people whose career is constructing paragraphs and putting paragraphs together to make longer papers, and yet we spend a lot of effort on that.

We also teach math, but not to train mathematicians. There are hardly any jobs for mathematicians. And yet we put in at least ten years of hard labor trying to communicate some mathematics to every kid in school and a lot more years for many more students who go on beyond that basic ten. My premise is that most of what we do in school is not motivated for preparing - the need to prepare the students for the jobs that will be available the instant they graduate. We think that teaching things that we think are important because they do something to the intellectual development of the kid. The kid's able to cope better on his own or her own to solve more problems independently, to see things more clearly, to reason about things on their own and not be at the mercy of the experts. The whole premise of the whole literacy movement in the last century was to make people able to function independently and to be able to cope without having to depend on a priesthood - an intellectual priesthood, and in some cases, a real priesthood, who were the keepers of the written knowledge. So this isn't really a very different thing.

Another reason that's often cited is that everybody is going to have to be able to use computers in the future. Everybody is going to be, all the time, running their computer to do something and so we better prepare people to do that. I do think people are going to be putting their hands on a computer more and more as time goes on, right in the home, ordering clothes from Sears, ordering airplane tickets, getting information about movies, things like that. But to stretch that argument to the point where your conclusion becomes: And therefore every person should learn how to write clear programs in BASIC or in Pascal, that's a big stretch. I don't think that stretch can be made right now, and perhaps never.

Again, I don't think that's a relevant argument. I think the argument is incorrect, but I don't think the fact that it's a weak argument undoes the need to teach programming to kids in school, average kids, all kids. For example, average adults don't diagram sentences. It's not only programs that they don't do or are not likely to do, they don't diagram sentences, they don't write book reports, they don't solve linear equations, they don't solve word problems, they don't prove theorems about triangles and they don't even add four digit numbers! All of those activities are school activities. They're not home activities. They're not grown-up activities. They are school activities. Why do we do them? If normal adults aren't going to do them in the course of their life, why do we do them? Because we think that doing these things causes a student to develop intellectually, to be able to do things on his own, to solve problems, to cope, to get ahead. We think those are important things even

though the actual school activity is not going to be copied one for one when they get out of school. They're not going to be doing exactly those things. So I don't think these arguments are good, but on the other hand the fact that they're weak arguments also turns out to be pretty irrelevant. Why should we teach programming then? I think the answer is that because just like ordinary human language and like mathematical language, a programming language gives a person a way, and a unique way, different from the other two kinds of language, a unique way to think about things. When you create a program you have a writing experience. You're trying to get ahold of your ideas and put them down in some kind of order and organization and then to analyze what you've written. When you write a paragraph in English and you know it's wrong, you get out the pencil and you start scratching things out and drawing arrows and moving sentences. The same thing is true of programming. You look at it and you say, "That's not quite what I had in mind. How can I make it better? How can I make it work?"

Programming allows the student to use those skills, the thinking skills and the expressive skills, the writing skills, and the critical skills --- to bring all those to bear on problem solving, using those skills to think about something, to understand that thing, and to write something that expresses what you're understanding of that thing is, and therefore to solve a problem. A programming language gives a student the same kind of intellectual tools that an ordinary language does, or that an understanding of mathematical language and symbols does. It gives a way to

do things that we think are terribly important in school in general. And the fact that a computer can carry out the steps of a program is almost incidental. It's really not terribly important. The important things that are happening are going on in the student's mind during the development and testing of the program that the student is writing. Of course, if there were no computer to carry it out, there would be no motivation to write the program. So it is critical that the computer be present and that the student not just write programs on paper but actually enter them into the computer and discover that usually they don't work, that they need some fixing. That's very important, but the truly important occurrence is that which is happening inside the student's head when thinking through a problem and trying to express it as a process. Remember, programming is just a description of a process. It tells the computer to do this, and then this, and then this and then do these three things five times and either to do this or to do that. It's a way of describing a process and whole domains of things we understand can be described very well in terms of processes. So computer language, basically, is a language to describe processes. A student should be fluent in whatever programming language is being taught. By the way, I think the choice of languages is very, very uncritical. It's not a very important issue. All programming languages are remarkably alike. At first they may appear different because the grammar differs, but really, in terms of how you express ideas, they are remarkably similar. Be fluent in the programming language that's being taught, use those linguistic skills, those computer skills to solve problems. Use software tools. I've emphasized here using a programming

language, because that is THE fundamental software tool of all. By knowing a computer language, you can tell the computer anything that can be told to the computer. When you use a spreadsheet program, you're already more limited. You can tell the computer to do some interesting things but you can't tell the computer to do anything you want. All you can do is deal with numbers and columns and rows and add them up and move them from place to place. But that's it. When you're using a word processor software tool, you learn another language, but it's a sub-set of a general purpose programming language. It's not the full scale. It's a language appropriate for dealing with characters, words, lines of text, etc. When you use a data base program, you're learning another language - the data base language. It goes with that program. Again, that's a powerful language to do a limited set of things. Once you leave that domain, that language poops out. It doesn't work. So, nevertheless, I think it's important to see some other languages besides a general purpose language, to see some narrow application languages. Computer literacy is knowing about the computer and knowing how to tell it what to do. This requires fluency in a programming language. Application languages are narrower but also useful.

Fourth on the list, is to understand how computers are likely to have an impact on the individual student and on society - careers, jobs, privacy of information, all of those things. In terms of overall content, I would put this down at about the 10% level - not the 5% level that my colleagues on the advisory board did. I'd put the software tools emphasis at about 10 or 20%, but that's a matter of taste.

Let's suppose that a school decides, "Yep, we want to have a computer literacy program and we want to achieve those goals for all of our students. How shall we do it?" Let's deal with how not to do it, a sure way to fail. I did an article in Electronic Learning, I think it was the April issue, which argues for what I think is the more successful way, but it points out the problems with the way some schools are moving right now. If your goals are to achieve those things we've discussed for every student, I think this approach is bound to fail. Put one computer in every K12 classroom. Now if you do that, that almost assures that students will get access to the computers on a very rare and casual basis. It's hard for a teacher to integrate an instructional tool into the classroom, especially a one-user tool or maybe a two-user tool into a 30-student classroom. It's hard to know how to handle that unless you're very skilled at having different students do different things in the same four walls. Very few teachers are skilled enough at that or enjoy doing that.

To guarantee failure, make every teacher responsible for a small piece of the curriculum. Now that computers are distributed all over the place, teaching has to go on, not by subject matter specialists, but by everybody. So they all also have to assume responsibility for teaching a component of a computer curriculum to the students in their regular class. Don't worry about teacher training, just count on the ability your teachers have to somehow magically acquire all the skills they need to teach this new subject. All of them. And then don't test for achievement, because if you don't test for achievement you won't have to explain why nobody learned

anything. Although it sounds silly, many schools are marching in this direction. It really worries me. Suppose you were a school that had no foreign language program and the principal woke up one day with the bright idea that every student should become French literate. How would you achieve French literacy? Well, if you followed this model, then what you would do is put 10 pages of French in every textbook, probably in the back. Then you'd have all teachers teach 15 words of French in their regular class, no matter what it was - math, science, English, whatever just so that they get in their few words of French. You wouldn't bother training because anybody could teach 15 words of anything to anybody else. And you better not test for achievement because after K-12 years of this, there won't be any achievement to measure.

What has worked is a very different approach which is a very conventional approach, a very traditional approach, how we do everything else in school. The way we teach a typing class is to put our typewriters in one place. We get ourselves a place that students can have access to, we schedule a course in typing, we give the responsibility to a typing teacher, we deal with the teacher-training problem. We would try not to hire a school teacher to teach typing who couldn't type and who couldn't teach typing. Test at the end of the course to see who learned and who didn't. That's just the plain vanilla way we do things in school. That's how to do French. We have a French class, that's named and labeled, with a list of objectives and goals that the students are supposed to learn in the French class. Students can enroll in the class. The responsibility for

teaching it is given to the trained French teacher. We test whether or not the student passes the course at the end of the course. It seems to me that this tried and true model is exactly what we ought to use when we're talking about starting a computer literacy program in the school. We ought to concentrate our computer resources in one place. I'm not suggesting you go around your school and collect all your computers and put them in one place depending upon how many you have. There are good reasons to treat some computers as AV equipment. A history teacher's going to want to run a simulation program in front of the whole class, and when that history teacher wants to do it, it's time to schedule it with the AV department, get it out on a big cart, put a big monitor on the front, on the top of the cart, so that on Tuesday at 10:30 AM the history teacher can run the Oregon Trail program. That's a terrific idea. But that history teacher is not going to use up the computer resources. It shouldn't stay in the history teacher's room. Unless the history teacher has something to use it for every single day, it ought to go back with the other AV equipment and be on call the next time around.

However, to reach the goal of making sure that every student in school achieves computer literacy and can do those things we have discussed absolutely the best way to do it is to have a lab containing computer equipment. The computer class or the computer literacy class should be labeled so that students can enroll. It should be designed so that all students, not some elite corps, can take it. The course should be designed from the start so that all students can succeed if they work. The

responsibility for teaching this should go to a specialty teacher, a computer teacher. Deal with the teacher training problem. Nobody has been taught how to be a computer teacher. Although I usually get away with saying that, in Texas I can't quite because Texas has the only model teacher-training program in the United States at North Texas State in Denton. Those people have been very, very well trained to teach a class like this. Most teachers will have to do like I did and learn computing on their own. They will have to scratch around and read books and get ideas and read magazine articles and try things out. Before long they will become expert. They will become expert - why? - because someone gave them a responsibility, it's on their shoulders. The teaching of students is their responsibility, so they do the job. If you distribute that responsibility among the whole staff, then it falls between a lot of cracks, and I doubt whether the responsibility will be taken seriously enough to get the job done.

And finally, at the end of the course, test the kids. Find out what they learned and what they can do. Don't be satisfied to have students just have happy faces at the end of the course and be pleased. They should, of course, but it's important to get back to your other constituents and say, "at the beginning these were our goals, here are our tests and here's what the kids learned." This is going to be more and more important as this subject develops and is competing for valuable resources from the rest of the school.

Beachhead tactics get the course off the ground effectively. You establish a beachhead in a limited way. Get all the troops on shore. Defend territory and you build a strength there. Once you're strong you can move out and try some other things. And if worse comes to worse, you can always fall back to your earlier position. It's not like trying to take over the whole school with one blow. I don't think computing should take over the whole school with any blows. In any case, the least offensive thing you can do, the thing that shakes the system the least, is adding one new course. Add a course, call it computer literacy, or introduction to computers, or whatever you like. One semester looks like long enough to accomplish some real goals. Have the computers available to the students in that class. The computers probably should not be in the classroom because it's much too distracting. Teaching computing requires a lot of just plain teacher-to-student communications in words to formalize those things kids are learning at computers. You don't want to have a mess of computers in the back of the room clattering away or kids chattering away, which they should be doing at the computer, to a certain extent, while you're trying to hold an intelligent discussion with the rest of the class. A lab that's adjoining the classroom or that's over in the library where someone else can supervise it, looks like a good idea. You need one teacher, a teacher who is the computer teacher. The number of computers needed to support a course like this seems to me to be about 8 computers for a teacher with 30 students. You want to have access to the students for this verbal communication; you also want to have a chance for them to do hands-on work at the computers. Divide your class into two groups and

while half of your class is with you in the classroom, the other half is at the computer doing a computer unit. The next day at the same period, the two groups of students switch. That way you only need computers for half the class at a time. Furthermore it seems to be a good idea in the beginning course to have students work in pairs because I've seen loners often simply follow directions and pay no attention, come to the end of the unit having learned very little that they can recall. With two students, each one is the other one's critic. Why did you do that? Did you see this thing on the screen while you were busy down here? So the chatter is useful within bounds. That gets you down to pairs of students, so you just divide your total number of kids per class by four and you get the number of computers you need to run the class.

One set of equipment can handle many slots of 30 kids in the same semester, in the same half year. In fact, there's a rare school that needs more than eight computers for all the students in a given grade level. If your school has fewer than 300 students per grade level, this is all you need in the way of equipment for this course, although you may need computer equipment for other goals. Suppose you have 300 kids in the eighth grade and you decide the eighth grade is the target grade. You're going to get everybody through this computer literacy course in either the first semester or the second semester of the eighth grade. And you've got 300 kids in your eighth grade class. What are you going to do - 150 of them in the first semester and 150 in the second semester? Now you're down to 150 - how do I handle 150? Easy - 5 sections of the computer literacy

class all using the same computers. It's scheduled for each period. It's used for that purpose. And even that way there's enough time left over to use the computers for other purposes as well, so it's not a big number.

You need to get together instructional materials that support the goals of the course. You have to find out what the goals are and come to an agreement as to what those are, and provide enough instructional materials to last for a full semester plus test instruments. You really have to be prepared to go to your other teachers in school and parents and say, look here's what we think these kids are learning. Look at our tests. This isn't very dramatic or romantic. It's something that you do just like all your other courses in school. This course is very straight-forward and direct probably around seven to nine when the schools are ready with a specialist teacher.

It's perfectly clear to me that typing skills ought to be acquired by kids no later than the fourth grade. It's just painful to go into a computer lab of seventh and eighth graders and watch them wasting that machine doing this. At the higher level there are other things to do, too. If a one-semester course is a target course or a required course for everybody, probably some students, maybe half of them, would like to go on for additional course work. A second semester looks like a good idea. There is need at the high school level for a computer science course and I think the advance placement course is a disastrously bad model for what high school computer science should be. It's a college level computer

science course taught in high school; it's not a high school computer science course. There is no high school computer science course I know about yet, but there needs to be one developed for the average college-bound kid, and maybe a data processing course for the average non-college bound kid who wants an entry level job in a modern office.

Johns Hopkins' recent work, '82-'83, looks at schools that have a predominately minority enrollment versus the average of all schools in the United States. A big difference in hours used per week looks terrific; kids in the minority schools have about twice as much contact with the computer as kids in average schools. Do they have a computer teacher present to teach them about computers? No, no one is responsible for teaching them about computers. What are they doing then? They're learning arithmetic. They're obediently sitting in front of the machine. They answer correctly and they get some smiling face. They are learning arithmetic, they're not learning about a computer, they're not in charge. The kid in the suburban school is being taught how to take control of the machine, to master the machine. One group of kids is getting the subtle or not so subtle impression that they're going to be the obedient servant of a machine in the future, and another group of kids is getting the opposite message: they're going master that machine and make it turn rings. Teaching programming is twice as great a likelihood in average schools as in minority schools. Use with below average students is another give-away that the computers are there for drill and practice and nothing else. I think this is a disaster and something has to be done about it. Before I

tell you what should be done I'll give you some similar data on male-female differences. The most recent issue of Computing Teacher deals with the whole question of equity. Students entering the University of California at Berkley were asked to answer various questions about themselves. Do you have a computer at home? Twice as many males as females did. Have you written a program in the past year for a computer? Twice as many males as females said yes. Sixth graders in California were surveyed on a test that is given to all sixth graders by the State Department of Education. Do you have a computer at home? Again, more males than females did. Typical figures (you'll see this in the Computing Teacher articles) indicate that in an elective computer class, about twice as many boys as girls enroll around eighth or ninth grade and it gets worse every passing year. Fewer and fewer girls are in those classes. So we need to do something about that and I think the solution is very simple. It's a meat cleaver approach but meat cleaver approaches work in other subjects: require the course. Make it a requirement of every student to take a course in computing. All students take ten grades of math. If you look at elective enrollments in eleventh grade and twelfth grade math or in elective science subjects, you get that same old two to one split with boys to girls. I think the solution is to require a computer literacy course of all students. That two-edged sword places a requirement on the student, but it also places a requirement on us educators to create a course that works for average kids. I promise you if you try to build a computer literacy course on the average BASIC programming book that you go to your bookstore and pull down off the shelf, most of those kids would fail. It's going to blow right up

in their face, because chapter one starts about variables and expressions and parentheses and all those complexities. There's no need to introduce that early on. You can get through half a course before there's any need to talk about arithmetic or operators, period. There's much more to teaching about computers and programming that has nothing to do with mathematics. You can keep that a deep, dark secret for a long time. Require the course and make sure your course is achievable and practical for the average kid in your school. I think both of those are goals that we can aim for and succeed at, but it's going to take work from both sides. The people who write curriculum have to keep in mind that they're not writing any longer for that elite bunch of kids who were high math achievers and wanted to know all the secrets of assembly language. They're writing for your average Johnny and Janie in junior high — the course has to work for them. So I think there's a simple solution in one sense and then a lot of hard work has to be done to make it happen. But it can be done and it should be done.

Computer Competencies for School Administrators

Jim Poirot and Ted Mims

Note: Due to partially inaudible content of conference tape, this version of Dr. Poirot's presentation was reprinted with permission of ICCE.

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Introduction

In our nation's elementary and secondary school systems there are many administrators who have little or no experience with computers. Others have limited experience using computers to perform only administrative functions. Many school systems have had access to large main frame computers for several years. A technological revolution in electronics has resulted in the placement in many schools of relatively inexpensive microcomputers that have many of the same capabilities of larger main frame computers. Interest of school administrators has dramatically increased in the use of these computers to help perform some school administrative functions.

Numerous studies have been undertaken which deal with the subject of computer literacy. Most efforts have been directed toward the area of computer competencies for teachers and pre-college students. Research in this area has been encouraged by government and professional organizations including the Association for Computing Machinery (ACM), which now has a special division dedicated to the use of computers in elementary and secondary education, the Elementary and Secondary Schools Subcommittee (ESSS).

Within the ESSS there are twenty-six task groups. The task group on teacher education has established computer literacy competencies that are needed by teachers. A similar list of competencies for administrators, however, has not been developed by the ESSS subcommittee on Administration and School Boards. A comprehensive study of computer literacy competencies for elementary and secondary school administrators therefore seemed to be vital to those interested in conducting workshops and teaching college courses for school administrators. It is anticipated that the results of this study may also be useful to colleges and universities that offer programs for elementary and secondary school administration.

In an attempt to identify computing competencies required of school administrators, a study was conducted by the authors to identify, validate and rank a set of such competencies.

Identifying Competencies

An initial set of thirty-five proposed competencies was prepared based on statements in the related literature {1, 2} and on statements provided by professionals in the fields of educational computing and elementary and secondary school administration. These competencies were then submitted to a validation panel, a group of ten authorities in the fields of educational administration and computing. All of these individuals are nationally recognized for their work and research in this area. These professionals judged the initial list of thirty-five competencies to determine which competencies were not appropriate and to determine whether or not additional competencies needed to be added.

Agreement was necessary from eight or the ten panel members in order to omit a competency. Competencies were added to the list if suggested by one of the ten and if in telephone interviews each panel member agreed to the addition. The attached table identifies the forty-two validated competencies.

Competency Priorities

After a set of competencies had been identified and validated, the level of importance of each competency was studied.

An evaluation panel was selected composed of thirty-one members

from areas that include (a) educational administration, (b) college or university faculties, and (c) computer vendors. The thirty-one members were selected on the basis of their being computer literate in educational administration applications. Eighteen of the evaluation panel members were practitioners in a field of education that utilizes computers. Six panel members were faculty members in institutions of higher education -- three of whom were from computer science departments and three from educational administration departments. Seven members represented leading computer vending companies; each company named its representative.

A questionnaire designed to elicit data regarding the importance of each competency was mailed to the thirty-one member evaluation panel. Twenty-nine usable questionnaires were returned.

Data collected from the evaluation panel indicated his or her measure of importance of each of the competencies. A five-point rating scale was used with a score of five being given to a competency if it was gauged to be of extreme importance and a score of one given if it was gauged to be of no importance. A mean rating for each competency was calculated by averaging the ratings assigned by each member to each competency.

Analysis of Evaluation

The forty-two competencies are divided into six broad categories

for purposes of discussion. These major competency categories are (a) computer literacy, (b) programming, (c) applications, (d) software-hardware, (e) resources, and (f) educational computing. An analysis follows of the evaluation panel members' responses to the competencies in each area.

Competencies 1 through 9 were placed in the are of computer literacy. These nine competencies have means that range from a high of 4.32 to a low of 2.90.

1.	Have a working knowledge of computer hardware and software terminology needed to communicate with data processing or computer professionals.	3.76
2.	Have a working knowledge of the roles and responsibilities of various data processing personnel employed in a typical educational data processing center.	3.48
3.	Be able to identify and discuss with the average lay person historical events in computing, particularly those related to education.	3.00

4.	Have a working knowledge of copyright laws as they apply to educational computing.	3.83
5.	Be able to discuss legal, moral and human impact issues of computing as they relate to societal uses of computers generally, and particularly educational uses.	3.97
6.	Be able to discuss values and benefits or computerization in education and society.	4.31
7.	Be able to demonstrate an awareness of future trends in computing as they relate to educational computing.	4.07
8.	Be able to identify, describe and demonstrate the function and operation of the various components of computers and related peripheral devices.	2.90
9.	Be able to identify the ongoing problems of computer ownership (maintenance, security, replacement, etc.)	3.72

Competencies 10 through 14 were placed in the area of

programming. These five competencies have means that range from a high of 3.52 to a low of 2.21, even though a majority of the programming competencies seemed to be of least concern to the evaluation panel.

10.	Be able to identify the three stages of data processing—input, processing and output—and the form data needs to be in for input or output.	3.17
11.	Be able to write simple programs.	2.21
12.	Be able to explain why a program will or will not run on a given computer (i.e. operating system, memory size, language of program, type of disk, etc.)	2.69
13.	Be able to demonstrate an awareness of computer software systems such as authoring languages or utility programs, which are used for the development of computer-based instructional materials.	3.07
14.	Be able to demonstrate an awareness of operating systems, electronic spreadsheets, accounting, data-base management, sorting and word processing and similar software systems.	3.52

Competencies 15 through 23 were placed in the area of applications. These nine competencies have means that range between 3.00 and 4.00.

15.	Have experience planning an educational data processing application for school administration.	3.10
16.	Be able to determine the elements of a district plan for computer-based instruction.	3.90
17.	Have experience designing a district plan for computer-based instruction.	3.24
18.	Be able to describe appropriate instructional arrangements for computer-based learning experiences.	3.79
19.	Be able to discuss ways to integrate the use of computer-related instructional materials with non-computer instructional materials.	3.83
20.	Have experience evaluating and assessing hardware configurations which might be used in instructional applications.	3.17

21.	Have experience evaluating and assessing hardware configurations which might be used in administrative applications.	3.45
22.	Be able to identify educational administration tasks that could be computerized.	3.97
23.	Be able to demonstrate an awareness of ways computers can assist in decision making.	3.86

21.	Have experience evaluating and assessing hardware configurations which might be used in administrative applications.	3.45
22.	Be able to identify educational administration tasks that could be computerized.	3.97
23.	Be able to demonstrate an awareness of ways computers can assist in decision making.	3.86

Competencies 24 through 30 were placed in the area of software-hardware. These seven competencies have means that range from a high of 3.79 to a low of 2.76. Six of the seven software-hardware competencies have mean ratings between 3.00 and 4.00.

24.	Have experience using a computer terminal and menu-driven programs to perform administrative tasks and generate reports.	3.31
25.	Be able to evaluate software and hardware for cost effectiveness, usefulness and ease of use.	3.79
26.	Be able to evaluate instructional software.	3.76
27.	Be able to identify the components of a data base (i.e. file, record and field).	3.31
28.	Have experience using a data-base information management system to make inquiries and enter data.	3.48
29.	Be able to adapt nontechnical software such as word processing and electronic spreadsheet to administrative functions.	3.69
30.	Have experience using statistical analysis software.	2.76

Competencies 31 through 34 were placed in the area of resources. These four competencies have means that range from a high of 4.17 to a low of 3.69.

31.	Be able to identify possible sources that can be used to help in locating hardware and software needed to perform instructional tasks.	3.97
32.	Be able to identify possible sources that can be used to help in locating hardware and software needed to perform administrative tasks.	3.86
33.	Be able to identify sources of computing related literature for administrators.	3.69
34.	Be able to identify possible funding sources for instructional and administrative computing.	4.17

Competencies 35 through 42 were placed in the area of <u>educational computing</u>. These eight competencies have means that range from a high of 4.34 to a low of 3.38. A majority of the educational computing competencies have mean ratings above 4.00.

35.	Be able to identify various alternatives for using computers in instruction.	4.00
36.	Be able to differentiate between various forms of computer assisted instruction.	3.38

37.	Be able to characterize the use of the computer as an object of instruction, as an instructional medium, and as a problem-solving tool.	3.86
38.	Be able to demonstrate knowledge of the unique characteristics of computers which can facilitate learning.	3.79
39.	Be able to justify the cost of educational computing.	4.34
40.	Be able to identify training needs of teachers for each of the uses listed in competency 37.	4.14
41.	Be able to identify training needs of teachers and administrators related to the administrative uses of computers in education.	4.00
42.	Be able to describe the computer training needs of students who will be entering the job market in the future.	4.07

Eight competencies have mean ratings of 4.00 or higher; thirty competencies have mean ratings between 3.00 and 3.97; four competencies have mean ratings between 2.21 and 2.90. Of all the forty-two

competencies, competency 39, "be able to justify the cost of educational computing," has the highest mean rating of 4.34, and competency 11, "be able to write simple programs," has the lowest mean rating of 2.21.

Using the mean ratings of importance, the competencies may be ranked in descending order as:

39, 6, 34, 40, 7, 42, 41, 35, 5, 22, 31, 16, 32, 37, 23,
19, 4, 18, 38, 25, 1, 26, 9, 29, 33, 14, 2, 28, 21, 36,
24, 27, 17, 20, 10, 15, 13, 3, 8, 30, 12, 11.

Examination of the ten highest rated competencies based on mean ratings, reveals that four of the six competency areas are represented. Five of these competencies are in the educational computing area, three are in the literacy area, and the areas of resources and applications each has one competency in the ten highest rated competencies.

Summary

Forty-two computer competencies for school administrators were established in this study. Thirty-eight of these competencies have evaluative mean ratings that indicated they were judged to be of at least medium importance. These thirty-eight would appear to be appropriate for use in preparing educational programs while the four other competencies might best be omitted or modified since they were judged to be of less than medium importance.

Included in the ten competencies that have the highest ratings, several competency areas are readily identifiable. Justifying and funding computer purchases, understanding training needs, identifying tasks and uses for computers, understanding social issues related to computing, and having a knowledge of future trends are deemed important.

Two identifiable areas represented in the ten competencies that have the lowest mean ratings are being able to write programs and participating in the planning, designing and implementation of administrative program applications. This seems to be a clear indication that programming is not considered important for school administrators.

It is our hope that this study will provide colleges of education, departments of computer science and others who are charged with the educational training of school administrators valuable information on the proper design of curriculum. Further research and study is also encouraged.

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BEFORE YOU USE IT, YOU HAVE TO CHOOSE IT: PURCHASING CONSIDERATIONS

Dr. Don Roberson

I've been in Jacksonville, Florida for six years. Up until a few weeks ago my division was called the Division of Research, Planning and Evaluation. Now we are Administration and Instructional Auditing. We go out and do actual in-depth auditing and research regarding instructional programs that we feel some schools aren't implementing.

Mr. Sang gave you a few statistics about Jacksonville. He indicates that we are the 17th largest school district, with 98,000 students, and an annual budget of about $333 million dollars per year. We have about $39 million in state and federal funds which come under my jurisdiction. Much of our success is due to standardization. All the textbooks are standardized through all 135 schools, student conduct is all standardized. So as we began to consider computers, Mr. Sang also wanted to approach computerization that way.

Prior to the summer of 1982, very few school had computers in them. Those few schools had PTAs purchasing for them, or the schools bought them out of their own funds generated by sales, athletic funds, money that they earned at athletic events, etc. He assigned me to head up the committee that selected the final hardware and software and what

direction computerization would take because of two things. One, I had control of the money in Chapter II grant funds, and then the State of Florida has allocated computer funds this last year. And second, because many of the things that we were involved with required systems. We try to do things by design and not by chance, because when you're considering 5,000 teachers and 98,000 students, one error can wreck you for ten years. It takes that long to recoup. Prior to the superintendent's taking office, we were in a lot of bad situations. No schools were credited, we were plagued by teacher strikes and other problems. He has changed that significantly.

The "Washington Windmill" usually has a few blips about federal dollars. I want to share a quote with you from the May 1984 Executive Educator. "In an attempt to avoid repeating the school technology fiasco of the 60's, when school systems spent millions of dollars on language labs, many of which proved to be of limited value, Education Secretary Bell was advising caution about school computers. Bell has warned school systems to go slow on computer purchases which are being financed in large part by Chapter II funds. 'The rush to buy computers for schools has reached fad proportion,' Bell says, 'and much of the software is no more than electronic page turning.'" That remark is less than 40 days old. The latest facts show that right now almost two out of every three dollars of block grant funds are being spent on computer hardware or software.

From September '82 until May '83, we were involved in this venture

of making final decisions on selection of hardware and software and curriculum. Many of the things that we've done to get computers in schools have happened in the last eleven months.

I feel our purchasing consideration check list might help anyone wanting to move into technology in a public school setting. These suggestions for discussion need to be considered prior to making any kind of final decisions.

The first question concerns the purpose. Why do you want computers? In the 80's schools must teach computer literacy and we MUST, we must be aware of the impact of technology. Do they appeal to all learners? Our research found something different from that in Jacksonville: not everybody liked them. Consider the possible reasons why you want to move into that area.

The second question concerns use: how will your school use them? For all students? for special groups? for administrative information? CAI? specific areas in the curriculum? instructional modes and management? Mr. Sang mentioned our student, Jesse Smith, who started his own software company. In the advanced courses that he will have ready at the end of the summer for implementation district-wide, he has chosen to give the Briggs test at the very beginning of the software to determine which method of learning is best for the learner. His software is diversified into six techniques of approaching the contents of the software. He tracks student

progress once he gets his pre-test results. Consider who will use the computer. What software is available? Consider the evaluation of software and ask who's evaluating the evaluators. Determine which computer software has been coordinated with your system. Is there a local management system? Are any user aids available? Check into current periodicals, and copyright restrictions. Most everything we've set up in Duval County has been networked, so we're running into the problems of many people who do not want to network their software right now for financial reasons. What hardware capabilities are offered? Again, I think when most people consider purchasing they think only of hardware, but that's really only one of the factors that you've got to consider. One good suggestion is to anticipate equipment life span. When you invest so much in software, then what do you do following that unless you stay with the company or if they continue to develop additional hardware that will handle that software.

We felt the reputation and services of the vendor were important including warranties, installation services, contractual agreements or licenses for software. Part of our agreement with Tandy is that we will cooperatively develop software to market through the Tandy Corporation.

How available is maintenance or equipment service? What is the frequency of breakdowns. Is local or factory servicing available? How long is turnaround time? Are maintenance contracts in-house or carry-in? You have to estimate annual budgets for maintenance. If you don't intend to develop some kind of maintenance capability within your district, it can

become very, very costly. The cost for four months for the maintenance of computers in our district was $340,000. What training in-service programs or self-teaching materials are offered or need to be offered? Whom do you involve in creating and conducting workshops? In our district, even though we have area assistant superintendents and then the assistant superintendents within a central office, principals report directly to the superintendent. He has made a promise to them that he will do nothing in the county without informing them first. We felt the principals needed training prior to involving teachers in the computer network system that we have set up. They received an extra day of training over what was provided the teachers, or twenty-eight hours to thirty-four hours for principals. At least they are one step ahead of the teachers right now knowing what will be occurring in the coming months.

What options do you have in financing? One thing being promoted is leasing equipment right now. We felt that with the funds we had that it was better to go ahead and purchase, but I think cost comparisons with competing vendors and determining your sources of funding is indicated. Block grant is probably one of the most common sources right now. Because in the State of Florida, it looks like the legislature is going to move in the direction of having computer literacy as a required credit for graduation starting in '86, they're starting funding now to provide for the purchase of equipment at secondary levels.

Where are you going to locate the computers in each of the

schools? Our schools range from 60 years old to less than three months old. We have open concept; we have closed, very small self-contained classrooms. We have some with a district of over 800 square miles. We have a lot of mobility with two naval installations and a lot of itinerant farmers that move with the seasons for crops and fruit production. We actually have to move a lot of portable classrooms around to accommodate the populations as they change even during the school year, therefore we had a very difficult time in choosing the location for the computers. We ended up having them all in lab situations. Each school has a room set aside although it did involve moving some of the Chapter I classes.

And finally, what support services are necessary? We looked around the state of Florida. We don't have regional service centers like Texas does, but we do have both university staff and the Tandy people. Long-range support planning is essential.

What did we do in Jacksonville? My very first task was to call the president or the chief executive's office of some fifteen companies. I told the secretary that our superintendent wanted to speak directly with the officer, mentioned the kind of money we were discussing in terms of purchases, and gave them a little public relations "spiel" on what DUVAL County had accomplished. We approached our selection on the basis that we had as much to offer the company as they had to offer us. After that, the superintendent then spoke to each one of them on the phone. Seven companies indicated an interest. During that phone conversation, Mr. Sang

highlighted again many of the things that I had said, via the secretary. He asked that a letter be written to us requesting participation in the proposal and continuing efforts. We had seven responses. On that, the superintendent then sent out a cover letter and we sent out what we called our microcomputer specs. We began to tell them what we were looking for in the next six to eight months. We started in September - block grant funds had to be committed by May. The second wave came in after July. We specified basically the three things we were wanting: 1) interface capability, 2) a lab network, and 3) publicity.

It was essential to interface with the Burroughs mainframe because we purchase our service through the city at about a million dollars a year for administrative services including payroll, personnel, and our student information management system in which we score standardized tests. Starting after spring break, we have about 3/4 of a million tests that we score via computer for closing a school and promoting students from grade to grade. All of the students' code of conduct are on those files with our standardized and local achievement test records going back to 1976. Since it was costing us approximately $1,500 to have a telephone line and a CRT in each of the schools that we're currently hooked in, we thought it useful to go ahead and find a company that could emulate that CRT so we can solve two problems at one time using that individual computer. As it ended up, the Model 12 was selected.

We wanted to set up a lab network. Now consider, this is in

September. We thought we wanted at least a minimum of 10 computers, five with 64K and five with 48K, five color, five green plus printers, graphics tablet, modem, and mainframe interface package.

We requested a written description of what they would give us and requested that they come on-site and demonstrate what software they had that they could network. The primary concern was the interface with the Burroughs 7700. After agreeing on that, we then gave them a series of questions. (I think I was invited here to speak mainly because Bill Gattis felt like he put so much time in in getting the contract that he'd make me pay him back!) We started out with simple questions concerning the characteristics of the microcomputer, but we felt we needed that kind of information back from the seven vendors so that we could compare and make sure the decision we made was the wisest and most effective for the kids in DUVAL County. If the BASIC language is in the ROM, how much ROM and RAM are available? Is the keyboard a standard typewriter style? Are alpha numeric and numeric keys separate? What size are the drives? Can the microcomputer be networked? How does the usable hard disk drive influence the overall nature and operation of the network? What peripheral equipment can be attached? Does it have an RS232 board? How many colors are available? Does it have resolution color capabilities? Where is the speaker located? Where are the color adjustments located? Are they in view and easily reached? Is the monitor part of the computer? Is it extra? Are volume control, graphics capabilities, and dust cover provided? Hardware questions concern mean time between failure for the microcomputer

and what component parts are included in the warranty. Is labor on-site repair with a minimum 24 hour repair time included in the warranty? Will the hardware vendor provide units to be used on a trial basis without a purchase commitment? What type of in service training will the hardware vendor provide for teachers in DUVAL County? What software will be included? Is there a list of compatible educational software available? What documentation will be included if the hardware is purchased?

We set up appointments for demonstrations. In some instances, the national headquarters recommended somebody local for us to deal with. We identified where the system was going to be - which room, what was available in that room, the measurements of that room. They would have a telephone line dedicated to the Burroughs 7700 so everything was set up for them to demonstrate. We requested at least three microcomputers in the exhibit, networking capabilities, a demonstration of the ability to emulate the Burroughs.

When they demonstrated the process, we asked everyone who came to visit, classroom teachers, PTA representatives, the union representatives, and principals to complete a form for us. They also indicated to us what kind of position they were in so that we could also cross-tab that data into the analysis. The seven who demonstrated were Sony, Wang, Commodore, Apple, IBM, TRS80 and Apple. When we got that information back, we analyzed it by microcomputer evaluation. From the combined rating we began to get some of our criteria for evaluation including the actual

demonstrations that we saw from the central office and the responses to the original set of questions.

From that step we evolved three top vendors IBM, Apple and Radio Shack. Mr. Sang began to become involved. It was necessary that all the proposed hardware be on the current approved bid list as we are not looking for reduced prices of equipment. We bought straight off of the state bid list, so what every other district paid for the hardware and software, we were paying the same. Because we're part of the consolidated government, we have to do a national search on proposals. That takes about three to four months, and we didn't feel we had that kind of time. The superintendent began to plant some seeds, and I think that we as educators need to take note of this. Here we are buying, and we have the power to negotiate and get what we want. We found that the companies were very willing to cooperate. We like to think of it as a mutual partnership, a strong corporate commitment that will serve to benefit the DUVAL County School Board as well as the corporation. At that time Mr. Sang planted the idea that he wanted at least one experimental lab at corporate expense in a school board location, plus teacher training with a national advertising program. He planted that seed and we were really asking these final three companies to come up with some creative ideas.

We sent a letter with the following specifications: ten computers, five color monitors, two disk drives, dot matrix printer, and software, a version of the LOGO programming language that is supported by

the microcomputer proposed. After we had received the first responses we began to sense that we weren't going to get a whole lot more than 90 day warranty, so we just specified a 90 day warranty. We requested a complete description of their recommended classroom configuration and a written plan outlining corporate commitment to training teachers including specifics of corporate-sponsored labs to use the hardware and software proposed. We wanted a written plan outlining corporate commitments to developing software that addresses specific county needs, a national advertising campaign and an outline of the corporate commitment to a national demonstration site for selected hardware. And finally, we requested corporate assistance in maintaining and up-grading the hardware we selected. We envisioned a central lab in five centers to provide the corporation with the opportunity to involve the nation's model urban district and software development hardware relating experimentation. DUVAL County wanted to establish a partnership whereby we could be assured that we maintain our national leadership roles, especially in the area of using electronic technology in education. The demonstration centers would offer the corporation opportunities to present an excellent example of how its hardware and software could be used in public education while tying it in with exceptional education. We have 14,000 (approximately 13%) of our students who classify as exceptional education students. We want to be in on the ground floor of any development that comes out of the corporation. At that time the legislature was looking also at developing in the regions throughout the state some centers that would serve math, science, and computer technology. We wanted to have Tandy or whoever involved with

establishing this center and helping us get it for the Crown Region, which is the area that we are in.

We analyzed the data in several ways. Apple, IBM and Tandy were the chosen three, but during this time IBM began to drop out by not really responding to what we were asking until the latter part of April when they came back in with a phone call from the national headquarters asking if they could get involved again. Mr. Sang let them get back involved and highlighted specifically what each company proposed in their national advertising campaign so that the superintendent could compare those as well as any new items that were contained in the last submission. Some of them were very creative ideas. One company was going to give us a van full of their computers and have DUVAL County written across the side. We'd have use of that van for 5 years to travel anywhere in the country we wanted. Some offered a lot of the equipment to be loaned out to individuals in the school system, but when it came down to the final decision, I think the superintendent approached it from the bottom line of hardware quality, software availability, the cost and the partnership. We selected the Tandy Corporation and we feel like we made a very wise decision. So far our efforts have been very productive. We currently have 15 color computers in two of the three demonstration schools. The last 30 will come in at the end of this year. That will give us 96 schools with 15 Color Computers and a Model 12. In the junior high we've networked 15 Model 4s without disk drives except two disk drives on the host. At the senior high, mainly for the advanced programming course that uses Pascal, the advance placement

course, we've got 15 Model 4 microcomputers with dual disks drives. We are approaching $3.2 million dollars.

I think the whole point is that, as the consumer, you have the power to really negotiate what you want to do. We can be very influential expecially with the publishers. Last night I spoke with a couple of publishers. They said they didn't have software for the Color Computer right now, but they said they were starting to produce software because Tandy had already presented them some statistics about how many Color Computers had been sold this year. As the market selects the equipment that you're using, more and more software is being developed. I think in Duval County, the answer to our situation is going to be to contract with our own teaching staff where they can insure that there is instructional correlation with our programs to get the kinds of software that we really want.

Planning for a Computer Curriculum

Dr. Ruth E Randall, Commissioner of Education

State of Minnesota

Dr. Ruth Randall was appointed Commissioner of Education by the Governor of Minnesota to manage the state public education system of 436 school districts. Prior to serving as Superintendent of Schools of Rosemount, Minne., she had many years experience as an elementary principal and classroom teacher in Nebraska and Iowa. Dr. Randall's doctorate in Educational Administration is from the University of Nebraska at Lincoln.

A philosophy statement helps provide general direction to an educational program. Goals are needed to develop parameters. Objectives, scope and sequence, and activities add the substance that allow teachers to move from general expectations to learner outcomes that are clearly identifiable as a curriculum.

A curriculum can be defined as a plan for the education of students during their enrollment in school which clarifies what will be taught, when it will be taught, and in what ways it will be taught. A district develops a curriculum for numerous reasons. Some of the most important follow:

1. To clarify for students, staff, and community the district's mission.

2. To define what learner outcomes/objectives teachers have responsibility/accountability to cover.

3. To define what outcomes/objectives students should learn at what grades and in which courses.

4. To define how instruction is to be organized so as to reduce unproductive repetition and important content variations.

5. To maintain reasonable consistency within a district's offerings so that students are able to receive approximately the same content in various sections of an offering.

6. To establish a common base from which local educators, individually and in a group, can plan for instruction.

7. To identify resources that teachers may use to teach specific outcomes and thus enhance the quality of instruction and reduce preparation time.

8. To help integrate learning in the various disciplines.

The development and implementation of a curriculum can have many

formats and designs. One model calls for a cycle of sequenced activity.

A variety of broad educational goals are proposed as having potential usefulness for a community's school district. A participatory process determines which of those proposed goals deserve the most attention in the district's instructional plan. A scope and sequence is developed to show how activity related to meeting each goal is distributed across the subject areas and age levels in the curriculum. More specific goal statements are identified for each subject area. Learning objectives are then specified for the classroom level.

Once these ends have been identified, the means to achieve them are determined. Content is selected. Decisions are made on how students will be grouped for learning and how instruction will be delivered. Appropriate media are then selected for the instructional process. As the instructional plan is implemented, evaluation and reporting take place, and changes to the plan might be recommended. Significant changes in direction are recycled back for school and community discussion, and the process begins again.

Technology fits into this process. In some cases, the district will desire to teach students about technology itself. In a world which increasingly depends upon technology, it is appropriate for students to become familiar and skilled with it in its own right. In such cases, technology is the subject of a goal. In other cases, technology will be used as a means to reach a goal by serving as the media of instruction.

STATUS CHECK CONSIDERATIONS

The following considerations are useful in conducting a technology status check in your district. These considerations may also suggest ways that technology could be integrated into the curriculum and used for administrative purposes.

1. What educational technologies are currently being used? (i.e., computers, telecommunications, television, film, cable TV, interactive video, low power television, satellite communications, microwave communications.)

2. How much educational technology hardware do you currently have available in your district?

3. Where is the educational technology hardware located?

4. What is the organization of their use? (For example, in labs, regular classrooms, in clusters of several different activities in the media center, etc.)

5. What are the present applications of technology in each of the following:

   - Instruction
   - Administration
   - Classroom management
   - Other?

   For your reference some examples follow:

Instruction:	drill, programming, tutorial, simulation, presentation (lecture), introduction/re-enforcement, problem solving, etc.
Administration:	word processing, scheduling, attendance, grades, inventories, budget, reports, personnel, transportation, research, etc.
Classroom Management:	grade book, testing, test scoring, reporting, record-keeping, diagnosis, prescriptive, grouping, curriculum decision-making, etc.

Other: career/guidance, counseling, staff training, community education, bulletin boards, electronic mail, information network, library circulation/ administration, food service, etc.

6. What skills do the staff have with the technology present in the district?

7. What staff development opportunities are available?

8. Is there a curriculum guide with an appropriate scope and sequence in the major subject areas?

9. Is there a curriculum guide with an appropriate scope and sequence for the use of the various technologies?

10. Is there a written plan with guidelines for implementation of the various uses of technology?

11. Are there advisory committees that are community-based as well as staff-based to provide an overall support network for technology? Describe structure and task?

12. Is there one individual responsible for the overall technology program implementation in the district?

13. Is there a centralization of hardware purchase, software purchase and equipment repair?

14. Describe any involvement your technology programs have with other educational agencies, organizations or business.

PHILOSOPHY

An effective plan for implementing technology in a school district begins with a clear philosophical statement. This statement explains the motivations that led the district into involvement with technology, describes the assumptions and beliefs upon which the plan is built, and suggests the general results that the plan is designed to produce.

DEVELOPING THE PHILOSOPHY STATEMENT

Utilizing a broadly representative group, several processes could be employed to initiate discussion of an educational technology philosophy for the district. Some sample processes include:

- Develop assumptions about the future.
- Develop a list of generalized concepts.
- Develop "why use" statements.
- Develop "we believe" statements of commitment.
- Delegate authority to a group leader or one or two representatives to draft a philosophy for committee discussion, modification and approval.
- Review philosophy and goal statements from existing plans and modify them for your district's philosophy.

GOALS

A district having reasonable resources may wish to develop goals by populations, phases of levels of implementation and curriculum/content dimensions.

Population Dimension

If a district's plan is to include ways technology will provide educational opportunities "for all persons," then the planning committee will want to identify goals which will meet the needs of a variety of populations.

Phases Dimension

A district plan should include ways technology will provide educational opportunities designed to provide for the individual differences of learners. It is unrealistic to think that any district will be able to identify and address all the needs of its staff and clients immediately. The plan should be implemented in phases with specific goals identified for AWARENESS, IMPLEMENTATION, and REFINEMENT.

Each phase has dynamics of its own, and changes or adjustments in activities will need to be made to ensure continued progress. The awareness phase will include activities which provide a common base of knowledge from which the other activities can be launched. The implementation phase will include activities which permit the populations to apply and extend the knowledge introduced in the awareness phase. The refinement phase of the plan should describe a strategy which permits the planners and participants to modify elements of the plan.

Enhanced Curriculum

A completely different approach to generating goals is to determine the extent to which technology will enhance already existing general curriculum. Goals should be identified which will expand and extend present curricula to include technology. This expansion and

extension might best be accomplished through an exploration of content areas.

Some possible areas are:

1. Information about Technology
2. Computer Operations
3. Computer Assisted Instruction (CAI)
4. Computer Managed Instruction (CMI)
5. Programming
6. Emerging Uses

Key Results

Another possible approach to the development of goals for a technology utilization plan is the "key results" method. This strategy involves brainstorming focused on the question, "What results or outcomes do we expect or want to occur after we have implemented our technology utilization plan?" Key results statements should be broad, general and concise. They need not be measurable or include specific time elements.

Naturally, in the brainstorming process many more key results will emerge than can be realistically addressed in the plan. This should be realized by those involved in the goal development process. Some key results which are proposed may become more specific objectives in the body of the plan while others may be grouped into more general key results for inclusion as goals in the plan.

TECHNOLOGY INTEGRATION

The most sophisticated type of technology utilization planning involves complete integration of technology with specific curriculum objectives. The integration of technology into the instructional program will impact on those curriculum objectives related to learning about technology and those objectives related to learning with technology. When a district plans for these two roles of technology in the curriculum, three basic changes will result:

1. Some objectives will remain unchanged, but their attainment will be enhanced as new technology is used to deliver instruction.
2. Some objectives will be modified because of the educational advantages created by the use of new technology.
3. Some new objectives will be added to express learning expectations not previously included in the curriculum which use of technology suggests.

Learning About Technology

In order for students to utilize technology as a tool it is necessary for them to be knowledgeable about technology, to develop skills in the use of technology, and to develop appropriate attitudes and values related to technology and its impact on society. Although each district will want to develop its own goals and objectives related to learning about technology, a number of topics seemed to have gained wide acceptance. When a district revises a scope and sequence to include learning about technology, topics such as terminology, operational skills, applications, uses in society, impact on society, history of technological development, and attitudes toward technology could be considered.

Beyond teaching about technology, educators will want to use technology as a means for delivering portions of the general curriculum. When educators have received proper exposure to, and training in, technology, they can begin to examine existing scope and sequence to identify places where the curriculum and technology match up.

Greater productivity and performance of learners is the result of planning for a computer curriculum.

For further information on PLANNING FOR EDUCATIONAL TECHNOLOGY, 1983 Copyright, write:

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Communications and the Computer

An Application Study

Lt. Col. Thomas E. McCann

Lt. Col. Thomas McCann is the Director of Research in Computer Based Education at the United States Air Force Academy in Colorado Springs, Colorado, where he is also a Professor of Physics. His professional background is in computational plasma physics. His Ph.D. is from the University of California at Davis.

The Air Force Academy has a unique environment where we think a microcomputer network which we're now installing is very important to our future and affects our communications and educational framework.

All military organizations have to have a very simple mission statement. Probably no other university in the country would be able to duplicate in its simplicity our mission: it's simply to provide the framework for career military officers and to motivate them to spend their careers as military officers. Now, the reason no other university can really do that is because of such diversity of things that people go to from their university environment, whereas our people go directly into the military service. They go in as Second Lieutenants in the U.S. Air Force, so we know exactly what their jobs are going to be and we can structure the curriculum and the foundation that we give them to address those jobs.

We have a common structure of engineering sciences, basic sciences, social studies, and humanities. The core curriculum is probably the most extensive core in the country in the sense that about 80% of our program is indeed "core" or prescribed for every student. That is more than the Military Academy or the Naval Academy or the Coast Guard Academy have. We are intensely looking at that because that kind of a structure provides a little bit of inflexibility. That core is 111 semester hours equally divided between social sciences and humanites, and engineering and basic sciences. We require 5 math courses: that is, every cadet takes 3 semesters of calculus, a course in differential equations, and a course in statistics and probability; three courses in physics, lots of engineering courses and so on. No one le es the Academy until he is a technology based individual. He has technological training; he has mathematics that every engineer has, through differential equations. Whether he majors in political science or history, he still has this basis and groundwork for his career in the Air Force.

Beyond those 37 courses, there are 23 major's programs to select from. You must select those before the spring break of your sophomore year. Although fairly broad in scope, there is no English major or many of the other things that you would have in most normal universities. Even though everybody in the Air Force needs language skills and needs to be trained in how to speak, think, and write, the English major per se is not an Air Force speciality job because the Air Force thinks more along the lines of operational jobs. Over 50% of our graduates last year majored in

basic science or engineering. Our graduates are usually very technologically oriented.

Our faculty is somewhat unique. We have all active-duty military officers except for a few visiting civilian professors, usually 6 or 8 a year who come to us for one year. For those 575 officers, 4400 students — 4400 to 574 gives you a student to faculty ratio of 8-1. Thirty percent of those people are PhDs, 30% are rated, and 30% are academy graduates. That's low compared to most universities. As you know, 90% to 99% of the faculty would be PhDs in most normal universities. We like to say this is full-time faculty, these are the people who are in the classroom and they are teaching the freshman courses and sophomore courses as well as the upper level courses, so they are indeed full-time instructors.

The great majority of our people are young captains who have had somewhere between 4 and 11 years of experience in the Air Force and come directly into the classroom to teach their academic discipline. They bring an infusion of youth and operational experience that provides the role model that we so desperately need in that kind of environment.

Technology seems to be a great revolution which is going to have a big effect on education. After we had just talked to the Dean of Faculty one day, we had been spending some time talking about the money we were going to spend and the networking we were going to do. We were discussing our teacher training efforts. The dean came into my office late one

evening and sat down. He said "tell me, is that damn thing a hoolahoop or not?" So I think there are skeptics out there who think of it as a hoolahoop, and we must convince them. What is the connection between knowledge and technology?

At the bottom of Bloom's taxonomy is a knowledge base, then concepts, problem solving, synthesis and evaluation as you proceed upwards. At the university level we try to give knowledge, and we try to progress them up this pyramid as many times as we possibly can so that they grasp the idea of learning to learn, so that they learn how to learn. Those who learn to learn can go out into life and continue that lifelong process. This knowledge base, as time has gone on, has gotten smaller, and progressively smaller relative to the size of the great knowledge in any particular field. Right now a university educated person in any disicpline except some of the very new disciplines, when he graduates, will graduate with a smaller percentage of the knowledge in that discipline than during any other time in the history of mankind. Therefore it is more important now for us to stress those fundamentals, to stress the basic learning process, and to take people up and down this pyramid as many times as we can. They have got to continue to learn at a faster rate throughout their life than we have had to learn before. When you get a PhD, at first you think you're smart. Then you realize that you know less about a body of knowledge than you did before you started the process, because with your greater perspective, you realize how little you really do know. So we all proceed in that business of trying to protect our own ignorance and not let

anybody know really how ignorant we are by learning little segments of things and progressing on.

Let's talk about the technology and how it affects the learning process and how we introduce it into this framework.

Right now when you think in terms of computers and other wonderful and new technology, most of these things are down in the knowledge base area, down in the drill and practice area where you are trying to get people to memorize or learn, to increase their knowledge base. Some move up into the conceptual area where you want to put together knowledge and come up with a concept such as Newton's Laws. Bloom's conceptual framework allows us to treat a large volume of knowledge. Problem solving, then, taking those conceptual notions and jumping up into areas where I apply new concepts and I solve problems with them, is what we really try to accomplish with our students so that they do learn that thinking process.

We are beginning to do some of that with good simulations, with good interactive activities that allow the student to be very interactive, very self paced, very individualized to solve problems. We can establish some paradigms to allow them to go through that process, but a lot of that is very rigid and we see that in our software as unfortunate.

The Academy went through a study on two fronts to examine several requirements. First, a faculty study done last year in the early part of

the school year was conducted by a faculty working group on computers. We had members from all of the divisions within the Academy to look at all of our requirements for computational capabilities. Four reasons emerged to do a microcomputer network. First, we needed very much to produce Air Force officers who were extremely competent in computers. The tools of the modern Air Force, airplanes, missiles, spacecraft, satellites, most of them, almost all of them in the future, will be computer-based, and our people who must interact with those tools must be operationally trained in those areas. Those who must make those decisions down the road must also be prepared. Not just choices between Boeing or Northrop for building anairplane, but choices of a satellite or a spacecraft or an airplane in order to solve the particular stategic problem that is identified in the arena of the future. Those kinds of decisions, given the magnitude of the DOD budget, can affect the economy enormously. Since our people will make those kinds of decisions in the future, we feel that more and more those decisions will be based on or involved with computer-based systems. Therefore these officers must be extremely computer literate or competent or computer proficient. We want them to use those computers in every aspect of their intellectual life at the Academy while they are there, because they are going to be using those computers in every aspect of their intellectual life in the Air Force. It is very important for us to have the means for them to interact on a day-to-day basis in most everything they do.

The second reason is that the denison of the Information Age needs

the information tool of the computer.

The third reason is recruitment. We must compete with MIT, Cal Tech, Stanford, and the top schools in the country in engineering and science to enroll quality individuals. In order to recruit successfully, we must provide the logical tools of education for the future, in our environment. We must logically employ them in our programs so that those students will foresee that and be able to select the Air Force Academy because of its intellectual environment as well as because of its football team.

The idea of microprocessor education obviously involves the electrical engineer in a way that the history major is not necesarily going to be concerned. But each one of our students who goes through a core course in electrical engineering indeed gets an introduction to microprocessors. In fact we have an Educom build-up system, and they all get to build up some things with that.

My fourth point is that the computer is going to have a profound influence on education. The information we were to gather and sort and allow the student to interact with is going to have a tremendous impact, as well as the instructional capabilities that we were able to do through tutorials and dialogues and simulations that we can put on board the machine. The computer is going to have a profound influence on education. Given these four reasons, we launched into the computer-based world.

Computer science students at the Academy are studying computer networks. Right now we have a North Star Net with 14 computers in a room of 14 North Stars where our computer science students are studying aspects of networking. We also believe that a computer network is very important in a communications sense, in a sense of grasping the world in which they will be in the future and all of the implications of a network such as file transfer over the network, bulletin boards, all of the other aspects of a network that are so very important in the future. Our network will be a broad-band network which will connect 3,000 personal computers with 5,000 drops. It will be localized in our particular environment which is very localized because all of our buildings are quite close, so networking them together does not present some of the problems of distributive universities such as the University of Pittsburgh with 40,000 students spread out all over the place. Brown University, according to the Brown Net article, strings wire through the sewers!

We are going to hard wire, although exactly how that will be done is not clear -- whether it will be fiber optics as the backbone. We are going to string a token ring network that we will be able to tap off of. This networking literature suggests many possibilities, but people are still not clear. We've gone through a concept of operation where every department has input as to how they would use a network. We've really forced it on them to do some considerable thinking because we're spending a lot of money and we are going out with a request for proposal on the street, and the technical specifications of how that is going to be done is going to be dictated by how people would use the network.

Let me give you an example. The English professor who is teaching in English 101 who has 10, 12 or 14 papers a semester from each of his students to grade and maybe has 5 sections of that class, has an awful lot of papers to deal with. The students who are preparing those papers have drafts and revisions, too. Suppose that that student could type his paper in his room on his word processor and then transmit that paper to his instructor's file. The instructor then looks at the paper, edits it, revises, or corrects it, marks it up with a red pencil or red lite pen and then sends it back to the file of the student, who looks at it at his convenience, corrects it, and transmits it back. Now that is one example of a paperless kind of environment where we could speed up a lot of the processes that we go through in terms of folks handling things.

Many of our students will just type a paper real rough, just type the thing and then give it to the instructor, because what is the sense in editing it twice? Do it once, so you don't spend much time on it the first time. Let the instructor spend his time correcting it, and then he gives it back to you and then you make a better paper. I think we can back away from a lot of those kinds of issues with the word processing and the ability to transmit that paper.

The bulletin board functions that are available, the calendar, scheduling your time with the professor -- how many of us have sat outside a professor's office waiting to get in there and have finally given up and said well you can't ever catch that guy, he's never in. To be able to put

yourself on his calendar, to access, that gives you indications of what a network system can do. There are a lot of studies going on that extend way beyond that. Consider a network system as well with communications satellites. Now I am now standing in my classroom and I deal with Henry Kissinger at Harvard giving a political science lecture to my students as well as his, then we can interact over this communications network. The possibility there is enormous.

Networking, we feel, is a very important aspect of this whole revolution. We will begin to look at the communications aspect of it in a very small way, and then we will expand. That very small way is the local area network that is a broad-band network, or we can transmit video, audio, and data over that network. We will do it in the environment, in the topology as the network people talk, where it is the most advantageous to us to do all of our concept of operation that we are now coming out with.

By the way, the things I am talking about won't be completed until the summer of 1987. We are in a phased process now where we just introduced computers to the faculty. We are starting faculty training and we will introduce the computers into the cadet rooms in the summer of 1986 d some of 1987. By that time we will have a completed network system that will involve the 3,000 systems.

According to our implementation plan, in 1984 we are going to install microcomputers in many areas through the faculty. We have an Air

Force standard contract which came out of Washington. It was a procurement action that the data processing people at the Secretary of Defense level came out with to produce a standard microcomputer, personal computer for the Air Force and the Navy. That standard microcomputer is the Zenith Z100. Our procurement action was to acquire initially 50 of those which we put out to the faculty in January of this year and we just ordered some 176 more for the faculty. Actually, of the total of approximately 220 for the military science people and the atheltic department, 176 of that 220 were for the faculty.

About half of our faculty members will soon have one at their elbow, but that's not the way to think of it because we've got some common se areas and some other things, and we are using them in a laboratory environment as well. We really won't have one per department member, which is the ultimate goal, by the way.

The 84-85 timeframe is when we are prototyping courses and installing machines in faculty and staff areas. We have a Computer Science 100 course that is a PASCAL language course for every cadet. 500-700 people per semester go through that course. Right now it is supported by a VAX 11780 with about 60 VT 100 alphanumeric kinds of terminals interacting with that VAX. They have some instructional material on-line that teaches ome aspects of computer science, syntax, and so on -- programming. That ystem which has been dedicated to that course for the last 4 years has 'een very successful. They want to investigate how to take that course from

the mainframe environment or the mini environment to the microcomputer stand-alone environment. Next year they will have 60 machines on which they will be doing that. At first there will be some honor sections involved with them, but in the second semester the whole course will be involved in the microcomputer.

That frees up the VAX. The VAX probably then becomes part of our network and we can use it for switching purposes. It is not a very good machine for many timesharing kinds of things. 60 terminals in that alphanumeric mode is about all it'll do, and if you have 20 or 20-30 in a graphics mode, then you've bogged them down as well. So you really don't want to count on a VAX too much in the timeshare environment of a network if you are going to use it as a terminal. However, the way we envision the concept of an operation of a network is that we will download files to the students' machines and will use those enormous numbers of CPU's, central processing units, that we have within those personal computers, to process the information, to do the computation, to do all the things that the student will be doing. So we anticipate the student operating at about 95-99% of his time in a stand alone environment, and there is just no other way to load up mainframes with 2,000 terminals and expect to have much throughput and much interaction without some extremely powerful machines that are very expensive.

I used to consult at Lawrence Livermore Laboratories. We had a system out there was just fantastic. Everybody essentially had a terminal

in their own office, but the computing power at the end was Cray's 7600's and about 6 or 8 different mainframe computers that provided 2 or 3 thousand terminals to everyone, and that kind of environment is very nice. They have tremendous computing power to do computational things but it's not the environment at the Air Force Academy. We don't do a lots of heavy-duty calculations except some in the research areas, and so our environment has to be considerably different from what you find in the national laboratories.

In terms of numbers, we will have 2000 in cadet rooms, that is the number of dorm rooms. Our initial plans call for one per dorm room. Initially we wanted a personal computer for every cadet, but when we started pricing things, we needed to cut our numbers in half. Instead of a personal computer to every cadet, we cut to a personal computer in every dorm room. The numbers there indicate 2000 or so in the academic area. Now this is actually only one portion of the project; other portions of the roject that have other funding sources where we'll have more machines that will be in the academic area.

Most of the software publishers are out there doing it K-12 because there is the market with big numbers when financing the development of good software, you certainly want to spread it out over as many folks as you can and get as much volume as you can.

In the university environment, where no two professors can agree on what ought to be taught in any one course, much less agree on a piece of software that is going to be sold to thousands of students, we are in a different ballgame. And so we think that development time is going to be enormous. We hope to develop techniques, organizations, procedures that will, I hope, make that process more efficient.

FOREIGN LANGUAGE: DOES YOUR COMPUTER SPEAK FRENCH?

Dr. Betje Klier

Betje Klier directed the Gifted-Talented program at Crockett High School in Austin, Texas where she is a French teacher. The Texas Foreign Language Association selected Dr. Klier as the Outstanding French Teacher in Texas and the Texas Foreign Language Teacher of 1983. Dr. Klier has taught Introduction to Computing at the University of Texas Division of Extension and published microcomputer software (POKER PARI) in French, Spanish, and German.

The purpose of the University of Texas Division of Extension is to provide timely instruction in response to community needs. Austin's highly educated population plus the (omni) presence of state agencies provides a barometer of needs and interests.

Several years ago, the University began to recognize the need for an introductory computing course which was not programming. Requests from the community seemed to be for a class to learn "computerse" so that a wide range of uninformed adults could deal with their sudden responsibilities to write specs for state agencies, purchase hardware for doctors' offices, or even buy a grandchild's Christmas present.

Introduction to BASIC bewildered many who attempted it. Computer salesmen frequently served up confusing answers in arcane vocabulary.

Besides that, what are the questions? An insightful program director, Frances Plotsky, wondered if this "vocabulary confusion" might be addressable by a patient foreign language teacher who knew something about computers. It was an interesting proposal.

I became interested in computers with a translating job at Intel, then bridged the gap between French and computing by studying CAI design with George Culp. Teaching a foreign language for years, then learning to use a computer as an adult, gave me the experience to sort difficulties as vocabulary, concept, information or confidence. The "trust trap" in adults is an enormous feeling of foolishness common to very successful professionals in a new situation where they feel incompetent, powerless, and curious at the same time.

In evening workshops adults begin to learn the computer's potential. I teach enough "computerse" for potential buyers to analyse and describe their needs. On a daily basis, however, I teach French. This section concerns computers in the study of foreign languages.

Foreign language classrooms demand varied and highly developed skills from the both the teacher and learner. Many people think that learning a foreign language is very easy until they get to a country and decide they are going to "pick it up." They find out about the special skills involved in learning a foreign language. In spite of all the different personalities and learning styles with which a teacher must deal,

students are expected to obtain a certain level of linguistic and communicative competence within a certain period of time, all the time amassing information about the people and the places where the language is spoken. A high level of individualized instruction is needed from an already overburdened teacher. Many teachers are overburdened, but foreign language teachers have special doses of fund raising, contests, individualized instructions in every way, plus passing out lists of French names for everybody in the faculty to name their new puppies. The foreign language teacher generally feels the responsibility of motivating students to continue their foreign language study beyond the minimal requirements. What can we do to help a teacher achieve such varied goals?

All the research shows us that the different methods of foreign language teaching which have cropped up or developed in the last 5, 10, or 15 years have "equipotentiality." In other words, it's not the method that helps the student learn, it's not the method or the choice of the method which determines how much a student learns. How then may a teacher increase his effectiveness? We say that the quality of learning increases in direct proportion to the level of the activity of the learner. Sometimes it's very difficult for foreign language teachers who love to speak their languages to sit back or keep silent and let the students do more and more of the participating.

The computer in education allows us to make learning even more interactive. Students are constantly cast as the participants in the

learning process, rather than as spectators. Logically, then, our teachers should seek to motivate students to engage actively in instructional sequences. Wilga Rivers, the guru of French teachers, whose wisdom is the last resort when we're looking for wise words, reminds us that steady improvement will come only from individual motivation and purpose. It is the student's desire to learn that will enable him to continue to learn at a rapid pace.

The society in which we live is a society in which computers have become a potential classroom medium for providing highly interactive instruction. Quoting Mulford:

> "Our society at large has discovered with breath-taking rapidity that which has been known to a subculture of mathematicians and engineers for 20 years or more. The computer is a totally absorbing toy, capable of sustaining interest to the point of exhaustion and beyond."

Both observation and research indicate that computers can be highly motivating. Although the technological advancements of the '70's brought computing power within the price range of an accepted school media,software to motivate foreign language students with multiple interactive experiences on the new single-user microcomputers did not develop concomitantly in either the academic or the commercial sectors. However, software had been developed in the '60's and '70's for mainframe time-sharing computers. Many people don't realize that foreign languages,

especially French, were among the most highly developed subject areas in mainframe computing in the '60's and the '70's. In several major universities many classes were taught using mainframe computing daily. The best example, of course, is the University of Illinois with the work of Fernand Marty. His work began to take a downward turn in the last few years, not because of a lack of success or lack of interest, but because equipment was beginning to break down. He was using plasma screens and some of his equipment was obsolete and irreplaceable or the government didn't provide funding to replace his equipment. The usefulness of his courses began to deteriorate based on the deterioration of the machines because the State turned its attention (and budget) towards microcomputers.

Reduced processing speed, plus limitations in memory and storage in microcomputers, however, at first prevented converting many of these mainframe programs to new individual-user microcomputers. Soon technology will again provide the processing speed and the storage capabilities of mainframes in the size and price range of microcomputers. We're caught in a hiatus there, however, during the period where, although we had these programs and had an understanding and sequences based on proven texts for mainframe computers, the micros which we have will not accommodate the numerous algorithms for error analysis on which this CAI was based.

Now the appropriate question seems to be, "In what ways can microcomputers assist foreign language students and teachers to achieve the steady improvement which comes only from the individual purpose?"

Microcomputers can assist foreign language students and their teachers with several different kinds of software. For example, systematic software. This is courseware which is integrated with other materials in a course where the courseware actually matches and supports what is taught in the classroom. There is trouble-shooting software which I find to be quite valuable. Either professionally developed or home-grown, the publisher or local school district prepares the software to solve a specific problem such as differentiation between certain kinds of verbs.

Special interest or topical software includes, for example, my program called "POKER PARI" from Gessler Publishing Co. on French culture and civilization. Another example is the D.C. Heath program which teaches the metro stations in Paris. If you've ever been to Paris, you know how much better off you would have been had you learned the metro stations before you left in the comfort and security of home.

Motivational software, slightly more useful than Pac-Man, includes adventure games prepared in French in Canada where French is the native language. For example in a medieval war game "le Temple d'Isphahan" (Gessler Publishing Co.) students incidentally pick up the French while devising military strategy. They think it's a reward but note: incidentally is not "accidentally." This is very sophisticated language use where the foreign language is the <u>tool</u> and not the <u>object</u> or the <u>goal</u> of the activity.

The most personal type of software is that which is developed by the student for himself and for his peers, often with teacher suggestion and guidance. Students with computer access should be encouraged from the very beginning to build vocabulary files and drill masters. In my bibliography, I make reference to an article where there is a simple program called "The Quiz Master." This is a one-page program which you could hand to any computer science student, even a BASIC student after a couple of months of class, and he could use this to enter the simple little program and use foreign language data.

When teachers and students can find more efficient ways to achieve some educational goals, they may then have more time for other goals that should be communicative activities which are based on spontaneous personal interaction. It is essential that the informed pedagogues with the imagination to design and evaluate CAI materials be supportive of their less informed colleagues. Researchers demands statistics, but academically sound programs must exist prior to such research. The momentum towards increased computing power and decreased price comes from the business community, not from the academic community. A concurrent and consequent need for software must be answered by educators so that software market needs will not be satisfied by the more responsive business sector.

Aside from creating a new language code complete with its vocabulary, phonology, and syntax, while achieving linguistic and communicative concepts competence, the students are expected to master

factual information about the culture and civilization of the country where the languages are spoken. The specific content area, culture and civilization, often lends itself to computerization because the teacher, the student, and the medium have certain qualities which make this domain easy to computerize. Teachers can provide independent study material because there is little need for modeling. If you're learning facts about rivers, you don't have to be saying words out loud all the time. Students can study independently because they know how to use other kinds of study aids such as workbooks and flash cards. The computer can store vast amounts of data and can be programmed so it will not be required to perform manipulations beyond its capabilities. For example, a microcomputer can offer a student several choices of answers in response to a question and check to see if the student has selected accurately. But if the program asks an open-ended question, the programmer would be required to generate absolutely all the probable responses in order to check correctly all the students. This would be an impossible task for such an area as culture and civilization.

Successful examples of mainframe computing in all domains of foreign languages can be not only cited but visited. You are welcome to come to the University of Texas and go see Victorine Abboud's graphemic program. Graphemes are just the letters and configurations to write a language. Her program is to teach Arabic graphemes. The example I cited earlier, Fernand Marty at the University of Illinois, can also be visited. Even if you don't speak French, you can call up the map and learn, for

instance, that Paris is on the same latitude as Vancouver. Most people think Paris is parallel to New York, but once you've seen that map and once you've seen the map of France and the little line going across to Vancouver, it's never forgotten. Visiting these programs is very inspiring. The success of these programs in each instance depends on matching the content area to the computer's capabilities. These mainframes have incredible graphic capabilities. Understanding the capabilities of the available computer and the structure of the task of the content area are requisite to developing successful programs. Instruction in virtually all language domains could be assisted by computers. As video disk technology, voice recognition and synthesis, and artificial intelligence continue to advance, language teachers can upgrade their expectations to exploit these media.

One of my favorite writers, Jernstedt, an educational psychologist, writes in T.H.E. Journal about the enhancement of learning from a collaborative situation. If you're used to dealing with junior high or high school students, you know the great advantage of allowing them to work together whenever possible. Compared to students working alone at the computer, he says, the collaborative students have achievement test scores as much as 42% higher. Conventional computer aided learning was about as successful as the lecture method, but was greatly improved, up to 42% higher, when students were allowed to work together. The inference is that the establishment of a collaborative environment might enhance many conventional computer assisted learning configurations.

The greatest distinction between audio delivery and computer delivery are in the code and in the activity or the interaction of the delivery. Foreign language teachers always bring up the question of. tapes and language labs. Tapes and labs deliver a message which is encoded in sounds, obviously the most essential part of a foreign language study. However, other media often expedite the delivery of the written word. The microcomputer effectively delivers the written word because of the effectiveness of the visual display in maintaining the attention to the lesson materials. The importance here is when you are talking about a language lab, the success of the language lab depends on the student's ability to judge his own production, and that's what he is in there to improve. Often a student is called upon to judge the accuracy of the very thing which he has been sent to the lab to improve. So, if he is not capable of accurately judging his own production, he is wasting his time.

The foreign language labs hailed as revolutionary in the '60's and '70's have all but disappeared in most institutions of higher learning. Research indicates that students do not necessarily learn most effectively in the restrictive linear style which characterizes the old language labs. However, state of the art language lab recording and play-back equipment imitates many computer capabilities such as randomly accessing specific locations in a program or branch into a more difficult task. This equipment does not evaluate student input, however, and leaves the learner again to evaluate the very aspects of the language which he is endeavoring to improve. The computer has the ability to match and compare student

responses; it does not have the ability to judge the student's oral output. I wish I could stand up here today and tell you that we have this wonderful invention that as of yesterday can gauge the accuracy of the student's output, but it is not true.

Video disk and voice recognition and synthesis seem to be more familiar to foreign language teachers than microcomputers. That is because they are similar to movies, sound strips and tape recorders which are already found in foreign language classrooms. Actually, a great deal of technology exists, both hardware and software, with which teachers have little familiarity because of the de facto segregation between the business and the academic communities. For example, machines are now available which digitize typewritten material. A piece of text is passed over a screen with the same motion as a familiar office copier. The text is copied, automatically entered in its digitized form into a text processor. Many uses exists for word processing in the foreign language classroom. The possible applications are limited only by the general lack of knowledge and experience with highly sophisticated technology. The tasks and routines of foreign language learning such as vocabulary acquisition and mastery of verb conjugations, cut across the individual languages. The similarity of task structures and content areas enhances the applicability of products because the same programs can often serve different languages simply by exchanging data. This affords teachers a great opportunity to design their own software, or at least to strongly encourage students to use their programming talents as tools for their foreign language pursuit.

When you're doing math problems on a computer you're actually doing math. You're performing mathematical operations, but French drills remain just that: drills, rehearsals. Personal interaction proceeds spontaneously, but controlled rehearsals of large numbers of possible responses can provide students with interactive tools which would equip them to deal with their language systems more efficiently. Wilga Rivers again points out that it is the students themselves who know how they feel about their learning partners. Such genuine interaction springs from the depth of the individual personality. Only the student himself knows whether he feels more at ease with a fluent speaker who can help or a less fluent speaker whose lesser ability encourages him more.

The same thing goes for the computer as a learning partner. He has to decide that. One of my favorite articles covering the research in microcomputer education was one which was written by Bracey with this conclusion:

> "Good software, obviously, has more potential for producing good effects than bad software. As I read through a lot of the literature on CAI research, I see a lot of home-grown software, some of which seems to have been printed so quickly that it is likely to be of dubious quality. The fact that we still find consistently positive effects with CAI may be the most substantive endorsement of educational computing yet."

Students consistently enjoy learning at their own pace and the lack of embarrassment over errors. When you read through the research about microcomputers, you can't help feel some sense of condemnation from what the students are saying. What do they like about computers?

Computers are patient. Computers are color-blind. They say many things which, if we interpret what they are saying, they are criticizing their teachers. There is much to be learned from the explanation of why students enjoy working at computers.

In 1982, as microcomputers became popular, the result was feverish activity in academic computing, even though there was no hard research. 1982 was a boom year for computer resources and software. A new generation of educational software exploded into the marketplace. I'm quoting Hunter on this:

> There is some irony in all of this activity however, for all of this invention and development and innovation, there was almost no formal research on any aspect of learning and computing in 1982. For very few schools had formal plans for monitoring or evaluating computer related methods, content, or courses. Lacking any specific basis for decision- making, educators invested millions of dollars in hardware, software, teacher training and curriculum planning - primarily on the basis of hopes and hunches.

Some contradicted the call for hard research at this time. Fortunately there were people out there who were saying the first order of business is to get out and see what we can do with the computers. Work with the new systems. Understand the special nature of the possibilities.

Another practical voice, one of the most positive and influential voices in instructional computing, is that of Seymour Papert who created Logo at MIT. In his Mindstorms he said, "If you're interested in learning how learning happens, you should start by looking at success

stories." Instead of presenting hard research about the effectiveness of CAI compared to conventional instruction, he tells a story or two, "little anecdotes about learning with computers that did deeply change everything for some people." This is a quote from 1980:

> It doesn't turn me on to think that we teach computing in schools because it is a basic skill and something that everyone ought to know. What does turn me on is the hope that computers in some sense might be the magic mountain. What I am really interested in is not teaching about computers, however important that might be, but rather determining whether knowing about computers can really deeply change everything else.

Although there is no generally accepted theory as to how people learn, theorists do agree on these two ideas: (1) people learn in different ways, and (2) the best way to learn is when the student plays an active role. Many computer experiences are an extension of the TV shows that children watch. Mr. Rogers and Captain Kangaroo often asked questions of their audience. Children answer although no one is listening. Young children interact more easily and much less self- consciously than adults. A high quality of student engagement can be expected when students are working on things that they enjoy or things that they believe to be interesting.

At an age when young people are struggling to master control over their environment and set themselves free from control, they learn computing together. They're able to randomize old notions of dominance, to feel inventive and powerful. Even at this conference people mentioned the fact that there are always fewer girls in the computer room than there are

boys. Some say that women's socialization makes them less receptive towards computers. I don't know. Psychologists say that females high in achievement motivation may have found video games such as Pac-Man attractive because they can strive for progressively higher levels of achievement at the same time. My experience at my own school is that the computer in the foreign language section of the school building is as attractive to girls as it is to boys because I don't permit loud video games. I think it's the noise and frenetic activity from the video games that scares off the girls. When there are text editing programs and things like that available, the girls go to the computers just as often as the boys. The loud noises, the pings, and everyone standing around saying, "Shoot, shoot!" scare off the girls. My socialization shows -- I do not tolerate that kind of rambunctious behavior inside the building very well.

I read in June, 1983 a headline that someone sent me because he thought a French teacher would appreciate it, "ROBOT TEACHES FRENCH, PLAYS GAMES AND FETCHES BEER." This was an AP press release. I had to have one of those! Closer examination revealed that it was really a robot and not a computer. His name was BOB, "Brains On Board." He had already been programmed to fetch beer from a special refrigerator. In the bottom paragraph, it said, "Ultimately he'll be able to teach kids French, vacuum the floor, and watch the roast." Such frivolous mention of teaching kids French is very common. Last summer the cover of Personal Computing announced, "Using Your Computer to Learn a Foreign Language." All of these articles come down to saying that you have to have a teacher to teach you

French, that a computer will only help. It's an interesting article however, and perhaps you should pass it on to your students and let them see how easy it is to program a drill template and get into the software business. A father created a vocabulary prompter which works essentially like flash cards to help his daughter who was failing German. She was 14 at the time. The vocabulary prompter lets the student create files of up to 50 words which are scrambled into a drill and practice routine. He talks about the superiority of this kind of tutorial over a canned list of words which might not be the ones that you need to study. Interestingly this illustrates how little appropriate software there is for foreign languages (or how little there was in the summer of 1983), that this could be the cover article on Personal Computing.

French is often mentioned as the potential application among other suggested uses. The one I mentioned before, the "Quiz Master", can teach you just about any kind of information that involves pairs of short facts. For example, state capitols - which is the first thing that everyone learns to do in basic computer courses. I especially enjoyed this article because he only taught 20 words in French and of those 20, just two were incorrect. That's a pretty good record, and the ones that were incorrect were very funny.

On the topic of synthetic speech, there is another article which mentions a student project, a gifted project, a bilingual project. It wasn't really a bilingual project. It was just that some students had

created some graphics and had written the text in English which someone had translated it in Spanish. A few seconds of speech accompanied some pictures. At the time this was done with just an Apple Microcomputer, he was digitizing with about 4K of memory per second of speech. Very little memory for speech is available with this process.

Keep your eyes and ears open for other answers to the problem of speech. Texas Instruments has just made a giant technological leap. With its speech board, a 10 megabyte Winchester stores 8 hours of speech. Compare that to 4K memory per second on the Apple. As people who are at least interested enough in French to come in here, you might be interested in a little ancedote. The French toy makers in their designs for Louis XIV invented gear-driven toys whose technology eventually led to the Industrial Revolution. The innovative way in which the toys operated in France led to the Industrial Revolution which took place in England. I find it very funny when I look at Texas Instruments and their Speak & Spell. Their on-going research in speech synthesis led first to the Speak & Spell and now it has led to natural-sounding digitized speech on computers. Toys can be revolutionary! Where will this revolution be?

The same information can be viewed from many different points of view. Last summer I was reading a business magazine (it's very hard to separate business and education these days) and found a headline where they were talking about language labs again. Educators who witnessed another great give-away during the late 60's, of AV and other modern educational

technologies as a result of a special tax legislation, noted that it had yielded a "wholesale and largely unproductive dumping of equipment on schools." One federal evaluation of the program indicated that as much as 70% of the equipment had gone unused. Again, we're talking about language labs.

Professor Daniel Peck, described as an educational technologist, was interviewed and he said, "I was part of all that. We introduced language labs into schools all across the country. You'd go into a school in Podunk," maybe he should have said Dripping Springs, "and you'd find a language lab. Those labs are 90% defunct." Tandy responded with, "what would happen if computers proliferate and there isn't the enthusiasm, training and software support to fashion meaningful programs? The one thing that we can't afford is to have some 13 year-old running around saying, "Oh yeah, we've got a piece of that Radio Shack junk in our room." It's a "major danger." We appreciate the efforts of Radio Shack to help generate the enthusiasm and training which will help counteract the same bad experience that we had with language labs.

Mention of language labs is very important because, although it sounds negative, it's really one of the most positive aspects of foreign languages and computing. In many institutions the language labs are there, the space is there. Where other disciplines are out looking for a place to park their equipment, foreign languages in many cases still have a place for language labs.

There are one or two more observations I would like to make. One is that we talk about setting teachers free to work with their students as one of the great advantages of using computers. I think that probably the most important side of that coin is that we would be setting students free from their teachers. I've always worked with gifted students and what we try to do is we try to set them on a road they can pursue for one language or for many languages, a grown-up path for educating themselves. That's one of the major advantages of teaching them, for example, to start out entering their own vocabulary. They learn that they can teach themselves along the way, and they learn they have this technological assistance as they go.

There is an attitude toward their students which is common to very effective teachers and should be extended to include computers. Limit your criticism and exploit your potential. Be aware of the limitations, but always keep an eye open for growth and improvement. Doing what you can with what you have is a good idea for computers as well as for students. Think, if Will Rogers were here, he'd say, "I never accessed a computer I didn't like." Whatever we have access to, we should use and appreciate and enjoy and help students to do the same thing. If you're a programmer or you have a programmer, you can select your hardware and your software or you can select your hardware and would be able to match the task to be performed, the capabilities of the machine, and your price range. If you're not a programmer, look at your software first.

To choose your software in foreign languages, one of the most valuable things is to join a professional organization. If you're responsible for software for schools, join the Northeast Conference or if you don't want to be a member, you can be on the mailing list of the quarterly newsletter. This is a composite of all the language organizations and its correspondence comes the most quickly to the schools. My article on microcomputers for French Review which was accepted for publication in November was published 13 months later. I held my breath to see what I had said at the end of 1982 on a topic where the morning paper often makes obsolete what was the "law and the truth" of the night previous.

While you're reading analyses of software, pay attention to description more than evaluation. If they end up saying this is a "3-star" what really matters is their "Why" because software evaluators are not always looking for the same things that you are. When my program fell into the hands of educators, it always received rave reviews, but I was ready to resign and go back to school and become an architect or hairdresser when my program fell in the hands of a game magazine which criticized it for the absence of interesting graphics and noises.

The best thing to do, of course, is to go to a demonstration of software instead of just reading evaluations. If you're looking for software integrated to a text, you won't have a whole lot of choice. We just adopted a new text in our district. Although the company also

produces excellent software, they don't match. The software does not support the text.

Anything that you can use, enjoy. People will get into the habit of associating "technology to topic." What criteria should be included in evaluation to formulate a "bottom line?" Two questions missing from most reviews are (1) what is the purpose and (2) will the students use this? For example, if the purpose is to review the subjunctive for the achievement test of the SAT, it would be specious to criticize the graphics. If the introduction is too long and can't be skipped, the program will gather dust. Does it have something special that students return to? Some software is as utilitarian and dull as grammar books, such as the vocabulary drill master. But if the student gets in the habit of using such a program to construct his own study aide, he becomes independent and bravo for him. If the software is too pretty with little challenge or holding power, will it be interesting for more than just the first few minutes? Will the students use it? They'll use <u>any</u> program once for 15 or 20 minutes. Is there something about it that will make them go back to it? The bottom line for software evaluation is: does the student use it? Does the student learn from using it?

Teaching the Talented and Gifted

Dr. Marianne Marrapodi

Marianne Marrapodi has had extensive experience designing and developing microcomputer courseware. With the Regent's Office in New York City, she is a specialist in gifted education.

The one million students and 60,000 children have precipitated this great boost of energy in New York City. We have it all in terms of our students. More than half of this year's National Westinghouse Science winners were, in fact, from New York City public schools. Many students who have been tutored in English proficiency and are taught by the other classes. Some of these classes are "emerging," which means they are called out for special English tutoring and I believe they are taught in their native tongue.

We have a large percentage of children who would be identified by any objective criteria as gifted and talented. This is the fifth year I have worked at the city wide level from the chancellor's office and I went to those schools that were labeled schools for emotionally disturbed children and found that they were filled with truly brilliant kids. At first I didn't understand until I started really watching those kids and getting a sense of what was happening to prepare them to fit into a regular classroom situation. In looking at these kids and these special classes, I thought "I am really glad they didn't have such things when I was a student or I would have been here." Because, as hyperactive as I am now, you should have seen me then! I was bright and a little bit more mouthy than I

needed to be. Fortunately some people labled me "fresh" and "very determined to explore new interesting things." A short time ago the "buzzword" the education field was "back to basics." Everybody wanted to get "back to basics," "really button down the hatches." We were going to be stern, and kids were going to get a "good old fashioned education." I think what back to basics meant was an education like I had, the education many of you had that allowed us to focus on reading or to focus on mathematics.

In the middle of the movement, microcomputers started sifting in resulting in back to basics on one hand and on the other hand this technology that has the potential to finally perfect education. It hasn't happened yet. We are experiencing many of the reasons why, but the potential is certainly there. Now all of a sudden people are talking about excellence and equity. Of course that is what we need: excellence with no one left out. For many years a lot of our gifted students did not receive excellence or equity partly because we didn't know who they were.

How do you identify a gifted child? The old very conservative definition was the top 1% of the population as measured by the standard IQ test.

The United States Department of Education said giftedness can, in fact, have many faces, therefore a variety of definitions of gifted children should exist. Now they are on the right track. What are some of

the ways they defined giftedness? By academic achievement, psycho-social development, or acheivement in performing in visual arts. As they were starting to refine a definition, these children's needs are beginning to be met in special ways.

What is equity? Is equity treating every person equally? I don't think so. In dealing with a million school children, I see no way we can treat every one of those children equally. What we do need to do is treat them equitably, find ways to meet the needs of each child.

Looking at a population in a different way permits us to identify them. How are we going to meet their real needs and our need to deliver excellence with equity? One of our obstacles is financial.

Two, we haven't always spent a lot of time dealing with teachers who had to work with gifted kids. Once we identify gifted children, what do we do with them? Do you finish the fourth grade curriculum during the second grade? And then what...do you finish all elementary school by fourth grade? And then what...send them to Junior High? Not in New York City you wouldn't. So something has had to happen.

I was a junior high school principal. In New York City you are judged by the reading scores your students achieve. Everyone sees the scores when they come out on the front page of the Times and every school is ranked order, therefore the leaders don't want special schools which

pull out the most talented students. This is called "creaming," and I don't want my school "creamed."

Fortunately in New York at least, we very much follow the Renzuli model to identify giftedness. He has come up with what I considered to be a very acceptable definition of what it means to be gifted and talented. He said that there are three criteria. It is an intersection of three circles.

Circle one is above average ability, not the top 1% of the old definitions. Renzuli said that's not necessary. The second circle is a task commitment. Can the child stick to it? And the third circle is creativity. And he said that the child who falls into the intersection of these three circles, above average ability, task commitment and creativity, is in fact a gifted child and needs special education. Renzuli did not believe in setting up special schools for the gifted, so he came up with his type 1, type 2, type 3 activities which the children were encouraged to pursue in rooms outside of their classrooms. The identified gifted child remained in his/her regular classroom and left to go to this resource room for at least an hour a week.

Some people have suggested we examine their textbooks. The EPIE Institute conducted a survey last year and they found that 60% of the average children in three cities knew 60% of the textbook without ever opening it up. Closed book. If you were giving the average child a test

at that point when you gave him/her the book, the typical score would have been 60%. What are we doing with these children anyway? The above average group, not "gifted," simply labeled "above average," knew 80% of the content of the book. Give a fifth grader a fifth grade history or geography book, and the above average fifth grader will know 80% of the content of that book before he/she puts the bookcover on it. That is pretty appauling. Terrel Bell has taken this up now as a crusade, has gone to publishers, and has made many speeches about what he calls the "dumbing down" of textbooks.

People say when they get the textbooks, they are too easy; yet schools aren't buying the harder textbooks. So we are caught in a "Catch 22" and we've got to make a decision as educators what we want to do. The publishers will follow suit because they are in their business to make money. And so if you were saying you want textbooks written on a higher level and you then purchase those textbooks, you will get them. If you say you want textbooks written on a higher level, then you go out and buy the same old thing, you're not going to get textbooks written on a higher level. And we are going to exacerbrate that war.

Realizing that textbooks aren't the answer for these children, some researchers started to looking at television which is mostly terrible. The reason television has failed as an instructional tool is because clearly the software was not there, but it has only failed as an instructional tool within the school building.

Let's not kid ourselves about the impact of television on education. It has been profound. These kids are there and they are watching that TV. Watching TV passively instead of reading or playing football or tennis or whatever youngsters do after school is not the only impact on students. Beyond that, they are learning patterns of language also. I know lots of children who have very limited English who watch "Dynasty" and their speech patterns are suddenly becoming a lot clearer. Why? Are they getting "educational TV?" They are learning something from Dynasty but, I am not sure that would fit within the standarized K-12 curriculum. They are learning to pick up words.

I met a youngster the other day, an eleven year old boy on the street and we just started talking. He said to me, "you are involved with technology, do you think computers are good or bad for the economy?" I was sort of stuck. I hadn't expected this question. And he said, "well, I mean I saw this show on Channel 13 about these people in a town who were put out of work because computers came into the factories and took over the functions that were once done by humans." I don't think when I taught elementary school I would have thought of generating a discussion on the economic impact of technology with my fourth graders. He was probably fifth and he started it. Technology has an impact. We simply haven't packaged it and we simply haven't turned it into 365 behavioral objectives, but the impact is there. We've been feeling it, we are going to continue to feel it, but it isn't the answer for our gifted kids because we can't use it well in the classroom.

You can find any one of a range of responses when you say computers in the classroom.

When we look at our gifted and talented kids and we look at these computers, the fit is obvious. Renzuli says in a type I activity that you expose kids to lots of different things. It is exploratory and you let them look at these different things and pick up things that they wish to explore. In type 2, you train them to think on a higher level, to express their thought processes, and to feel and to express these feelings. And then finally in type 3, the children are in small groups which set up projects that they wish to explore. You could call it problem solving, because it is a real problem. Not only that it's suddenly giving children power, it's not a false choice like so often we use in the schools.

You may choose a project on anything you want, here are 10 topics. Is that a real choice? Renzuli's model is a real choice. The child, or the group of children, picks this problem and they explore it. They bring to it appropriate research skills, carry out their research, and report their results. It is very real to the children.

So how do we use computers with all of this? Here we've got this group of children who've got energy and stick-to-itivness. I keep hearing about the 20 minute attention span of youngsters. I have seen lots of kindergarten and first grade youngsters who have to be dragged off those computers at the end of 45 minutes, so when we talk about task commitment,

let's not set an abitrary standard because one of the things computers are doing is knocking some of these standards right out of the window. Forget the 20 minute attention span if any of you have 5 year olds or 4 year olds. It is really a 20 minute attention span for Smurf or Woody Woodpecker, but the 20 minute attention span is totally false with this technology which has intrinsic motivation. So once we get our kids into the computing end of it, then let's look at the world we are opening up to them, the programming world.

Programming is problem solving if it is taught as a process and not a product. Is our goal to make every 10 year old in the United States of America a proficient programmer or to make sure that every child will be able to leave high school and get a job as a programmer? I hope not, because if you have been looking at those bureau of labor statistics lately, programming has peeked and is coming down.

No, rather approach programming as a process, because the process of programming is the process of problem solving. It is 1) defining a problem, 2) exploring different solutions, 3) setting up a solution set called an algorithm in the jargon. Then and only then do you code it, do you write it in BASIC or PASCAL or LOGO or Fortran or whatever language your school happens to be using. The process that comes at the end is the least significant of what happens in programming: Coding is a very trivial part of the process. The rest of the problem solving is mechnical, finally running and debugging the program.

But if your children are working together in groups and if they are dealing with these problems together, you have also opened up to them the world of bouncing ideas off each other. It is something we tend not to encourage in schools as much as we should. Usually there is the answer, but here we are not dealing with answers at all. We are dealing with process, and we are encouraging children to explore the different ways they arrive at a conclusion, to discuss them with each other. If it didn't work, if it had a bug, how can they fix it? What you are really doing with that process is called "metacognition." You are encouraging children to think through their own thinking process or to think about thinking. I don't know how much more relavant in terms of problem solving you can get than to examine your own steps with someone and say "Oh yeah, here's where it broke down. If I do this maybe it will work."

We adults talk to each other all the time. "Hi, I've got this problem, I'm sort of stuck in the middle, can you help me?" Too often when children do that we call it "cheating" or "do your own work, Sally." So this process of programming does away with a little of this and opens up that world to our gifted kids.

SPECIAL EDUCATION SOFTWARE

Dr. Victor Fuchs
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Victor Fuchs founded LINC which pioneered the marketing services to arrange for commercial publication and national distribution of R & D efforts funded by U.S. Department of Education, Health and Human Services which increased private sector participation by over 600 percent. His degree in communications and broadcasting is from the University of Wisconsin.

The LINC corporations are involved with contract work for the U.S. Department of Education to operate their marketing program. We take federally funded research given to school districts, colleges, universities, and other organizations, and evaluate its ability to be commercially published or distributed through commercial publishers. That's another way of getting the best from the field that the field has developed back to the field via the mechanism of commercial distribution. Computer software, books, films, and electronic devices are involved. The corporation also is involved in the research and development of microcomputer-based programs and such things as high resolution graphics. We have worked with the U.S. Department of Education since 1977 on their special education programs. I have been involved with working with the Federal Government since 1972 with the Bureau of Education for the Handicapped. Although I have some measure of overview of at least the areas that we have been involved within special education, I am not a special educator.

What do we mean by "special education?" I will take the

government definition of all the traditional handicapped or exceptionality classifications including the mentally retarded, the learning disabled, etc. (I believe the federal government, at least the Bureau of Education of the Handicapped, deleted the gifted from their consideration of special education. Most of the emphasis of the federal government programs is on area of exceptionality other than the gifted at the present time.)

Several ways of looking at software for special education should take us back to instruction and instructional values. A piece of software is nothing more than another medium by which instruction or information can be conveyed, as opposed to a textbook, as opposed to an oral presentation, as opposed to a film interactive video disk or mediums of that type. Let's consider factors influencing special ed software.

First of all, I think we all accept computers as an in-place technology for influencing education and being used. Approximately 70% of the schools in this nation have at least one or more computers. Of the 81,506 school buildings, 70% do have computers. By 1987 one computer at least is predicted to be installed in every building. About 750 software distributors in this country at the present time are supplied by probably between 425 and 450 producers of software for the education market place. All the mechanisms are in place to produce software, plus the fact that school districts are teaching their own students how to produce their own software for their own courses.

The second factor, marketing and distribution patterns of the commercial sector reflect most of the traditional ways of getting software to you, i.e. direct mail, sales representatives, dealers, etc. After being saturated with brochures, catalogues, descriptions of software, then we have to find out how should we make selections of the software most appropriate to meet the needs of our students.

Third, consider consumer demand or school demand for software. Teachers or instructors generally take a look at their individual students. Based on the needs of their students, they try to match the resources available to them, including computer software, to the needs of the students. By law every special education teacher must follow an IEP, an individualized instructional or educational program generally made by committee of the teacher, the parent, perhaps the social worker, the reading specialist, the principal, or others who create a mini-curriculum. An IEP is in one sense a mini-curriculum of the small incremental goals, the annual long and short term objectives for the student. After the very nice meeting at which everybody agrees, the teacher is left with the problem of how to accomplish these goals. That is an aspect of computer managed instruction where I personally think we have a misdefinition of terms in our computer management. I think it is the teachers who manage instruction, and the computer resources provide facilitation and resources and references for teachers to use in the instruction of those individual students. Teachers are a factor in the selection of software beginning with the problem of just gathering the information resources to know what

types of software for special education are available, up to knowing what may be most suitable for use with a particular student.

Administrators, including curriculum coordinators, special education supervisors, media specialists, are involved in the selection of computer software at different school district levels, but there is no uniform pattern that we can perceive at the present time as to how schools are selecting their courseware and software for special ed.

Those we'll call regular education students for a moment, as opposed to special education, will have a stronger influence on the types of software that schools will purchase. In regular ed, I think students want more access time on computers to improve their own computer skills. Students will also influence software selection by the fact that teachers will receive a form of praise from students when students recognize that the teacher is computer literate. Therefore, you can get the psychological influence of a teacher who wants to receive a type of praise or a type of recognition from students in the software selection, and I think that many teachers, particularly at the secondary level with their brighter and gifted students, are asking students' opinions of courseware. We have a real dialogue going on, and students are actually influencing the selection of software. It will probably take a while for that same type of scenario to happen with special education students, but I believe it is possible.

We must assume that the consumer in the market place, specifically

those professionals working in the school districts, be it the teachers, the administrators, or the students, will be able to discern the best of what's available to them from that which does not meet levels of criteria.

What are some qualities to consider while choosing software? Good software has a timelessness aspect. Most school districts do not want to have to think about reprogramming large amounts of software on a per annum basis. We hope to select software that is good this year and next year and perhaps the year after. Just like Basal textbooks, certain skills taught through software need stability and duration over a period of time. Basic skills are important. In most states there's a minimum competency standard applied through all of the school districts. Like any educational material, software must have the inherent ability to be meeting the minimum competency standards by the type of information that's being conveyed in the software. "Basic skills" takes us far beyond some drill and practice types of programing. I think we need to incorporate into our basic skills concept critical thinking skills. More than just the ability to remember where you last saw the number, we have to build in the synthesis skills that students need to make decisions. We have to teach them how to abstract information out of data. There's a big difference between data and information! Data are the components out of which information is constructed when it's relevant to a particular situation. We hope to find these kinds of skills, and communication skills, and independent thinking skills in our software.

The language level of software must be appropriate for the grade level just like a book must be written at the appropriate language level. Age appropriate materials are also involved. Many people in special education find that they do not have age appropriate materials. An individual who is 19 years old, mentally retarded, and functioning at a fifth grade mental level should not have a piece of software dealing with a little child's building blocks to teach math. We find out in many cases that the 19 year old mentally retarded individual is very interested in cars, very interested in the other things this person perceives within our society. We need to avoid "labeling" which limits our students instead of encouraging them to grow and blossom. An important factor for those who are producing software or looking at software for special ed is the pacing of age appropriate software. Self-pacing is, of course, a very nice feature of programing.

How does the program handle task analysis? How does the sequencing build on one part to the next? If you have a student who is capable of making quantum jumps in some areas but not in other areas, will the software program allow him to accelerate when he can and will it hold his hand, at those times when he has a difficulty? The software program should be able to accommodate both of those responses to instruction.

The affective domain is quite important to many special ed students. Humanization of all software is very important, but we have to understand what the affective domain limitation or horizons or parameters

of those individual students are. Research suggests that the reactions of special ed students to computer graphics often differs from the reactions of regular ed students. Research indicates that the ability of how to create better memory and better recall or gestalt, including the whole principles of identifying how you can attach and associate different types of memory to different specific events, can be developed deliberately.

Some student characteristics indicate a need for adaptive devices. Obviously, in the area of special education, and particularly orthopedically handicapped students without fine motor coordination, access to the computerized instruction must be through adapter devices, for example devices that pick up eye movements or enlarged buttons that a person can strike. Beyond this is the need to understand the input, receptive, and expressive abilities of the student. Most special educators are used to looking at all of these factors and the learning traits of each of their students. You can see just from this discussion that special education or software produced for special education differs or does not differ by definition from software in regular education.

Some technical variables merit discussion. What about graphics? Graphics are the illustrations as opposed to character displays. Character clarity is the letters, the A, B, C, D, the numerals 1, 2, 3, 4,. A character generator is a little electronic device that will put those types of images up on the screen. How far back do you stand from the display screen and the image is still clear? How close can you get? What about

figure-ground discrimination or the number of colors available? For some visually impaired students, colors not in contrast enough -- for instance, or for someone who was color-blind or for someone who has a visual problem, they couldn't see clearly. Other students have difficulty with the proximity of the print, with just print size or how much information is on the screen at one time, how fast the screens change or how rapidly the scrolling is done.

Next, there is again the issues of how rapidly the computer program advances, the pacing, as well as the branching question. It would seem obvious to most of us that branching is a good thing, but some people cannot logically follow the branching alternatives that the programmer has built into the program.

The instructional format dictates whether the computer program stands alone or is interactive with a piece of print material that the student works in front of the screen. How much keyboarding is necessary in order to make the software program work? Is it a touch screen for the program? How much communication may be required?

Traveling around the country recently into several states, I've been in the rural areas of those states where I find a much different scenario. I found, for example, that 65% of the teachers have no access to computers outside of schools; 21% of them seldom use computers; and 12% only use the computers three to seven times a week. Also, only 2% of the

teachers use computers on a daily basis. I find that in the area of training, 19% of the educators are self-taught in how to use a computer; 23% get help from a friend or another colleague who learned how to use the computer; and, 52% learned by going to a workshop. Many teachers are actually involved in some type of a formalized course or seminar go and avail themselves of the 6 hours of training that Tandy will provide, a great opportunity. You just go in and say you're an educator with a class of fifth or sixth graders. (I've been telling my friends to go down to Tandy tell them that they're educators!) Now, I'm just joking, but Tandy has really opened their doors and that's good. What about student access? 63% of the students have access; 37% of the students do not. 31% of the students are actually using the computers. The average student right now is only getting about ten minutes of access or computer time per day. In fact, if you wanted to get <u>all</u> students in this country having access to computers by 1990, we would have to have an installed computer base of something like 5-6,000,000 computers in the schools. That's a long way from where we are now for each student to have just ten minutes of access per day. I think we will recognize that that will be offset by home acquisition of computers, and it may very well be true that the average student will have more access time per day on their home computers. It means that computers and software are a scarce resource at the present time in our schools. We have to treat it as a scarce resource, and that means we have to manage it extremely well.

What are these districts finding in terms of student use? First,

they're using the computer so the students can learn about computers. Secondly, they are using them to learn how to keyboard. Then they're using them for drill and practice, or as a reward for good behavior. They're learning programming skills, then comes direct instruction, and after that comes teachers using it meet their IEP requirements in special education. They call "direct instruction" where certain components of the instruction where the computer program handles a certain portion of the direct instruction. IEP development includes records keeping, reward for behaviors, teacher programming, vocational training, diagnosis, and assessment.

All of us have been aware of the fact that there have been a number of articles published on the consequences if we do not get computerized instruction into our education system and bring up a society — the next generation — so that they are technologically competent to meet the challenges that will be set forth for all industrialized nations in the world. Right now, the data that we're getting or reports are telling us that the United States is fourth in its ability of its work force to understand and use the technology that it already has in place. Now if that is true, indeed we all have a great challenge. We are challenged not to further handicap the handicapped, but to assist these students in being able to do the tasks that we would consider normal for a student to do in a normal everyday academic environment. I see that in this audience right now we have some mildly handicapped individuals. Everyone wearing eyeglasses is mildly handicapped. Take your eyeglasses

off and you have a great test that the rest of us can't do. When you're looking at these computer screens, take your eyeglasses off and see how visible the computer screens are. You can roll play in a very small way how visually impaired students would go through with the same computer programs. The challenge of those involved in special education is to use the computerized resources and the special education programs to help meet that challenge of getting them to normalcy.

Our special resource at Link is a publication called "The Special Ware Directory" listing most of the computer software that were specifically designed for special education from 174 publishers in the country. It contains cross indexes by computer model, by handicap type, by grade level, by professional level, by subject area. This publication purposely contains no evaluation of the software. It is designed as a resource book to assist professionals in making some initial decisions about what software they may wish to preview. Although we believe, at least within Link, that there is a value of published reports and reviews of software, I still want to look at the piece of software myself before I will commit it to the instructional program that I will be using with my students. For special educators, it is the individual teacher who is legally liable for carrying out the goals of that IEP. If you're responsible then I believe you must take the care to look at it for yourself. This index is distributed at $16.95 by Oryx Press in Arizona. (Please contact them directly at 800-457-ORYX.)

Four baseline considerations are germane to special education software and to education. The first is content versus instruction. I believe that it will eventually be recognized that computers can store facts or information better than any single human being. As instructors we have to manage the instruction and the IEP. After the IEP is written and that team leaves that IEP planning session, the individual teacher has to translate those instructions written on paper and those goal statements into reality. In the educational community we need to recognize that computers can be the depositories for content, but the teacher is the one who is most appropriate to manage instruction. Our minds as a computer are still amazing devices, but I do not believe that artificial intelligence in computers will replace the ability of one human being to analyze and instantly reflect on all of that, and particularly in the area of the affective domain. A lot of our teaching is based not just on hard facts, also on the perceptions we get as we look at students. We read their moods and their environments before we make adjustments in our presentation of information after interpreting those signals. Computers make no value judgments, they only have the value judgments that are programmed into them by somebody else.

Divergent versus convergent orientation should be considered, two basic classical learning styles that have evolved out of the Industrial Revolution. Divergent, is basically where we are taught to explore all types of subject areas and all of the parameters of those areas. After a given amount of information, we make the gestalt in which we say, "Aha, now

I understand how all these things are associated." The convergent orientation used in industry and industrial training, is when the learner is not given any information that does not forward the ultimate goal of what the manufactory or informational process is. Time is too valuable and you must train large groups of people to do certain functions and to perform at a certain level, and you just don't have time for their minds to wander off. I think we have to blend the skills of both of these methodologies in our programming of computer software. Right now I think that most of our computer software is on the divergent model. I think a good teacher is the person who makes the decision of what must be learned and how the student will learn it, rather than what can be learned. We all have the problem of time. We only have students for X number of minutes or hours a day and you cannot go back and recapture that time to a large degree. I do believe that computer resources will take us beyond self-pacing into a critical mass capability of teaching by the convergent method of teaching those critical factors that must be learned to meet minimum competency standards to get the student over the hurdle. This will require redesign in curriculum.

Questions must be asked now, not in the future. Do we need to teach students that 2+2=4 when every computer can be programmed so that it always happens all the time. Is it important to occupy the human mind with understanding that process? We may have specialists who will be mathematicians, but in the future do we have to teach that to a handicapped student so they can go out and live in society? Is that relevant and

important to them? What's relevant and important to them may be that they can count money. Can they get a job? Do they know the telephone number or their way home? What is relevant and important might be that we can teach them how to use the communications devices that we have. Computerization will create an objectivity. You can't tell if a person is handicapped if they're interactive on a computer line. They may be physically handicapped, they may be mentally handicapped, they may have a certain of mental retardation where they are not very good at one thing, but they may be a whiz at another. When they're interactive on a computer data base and they're having a dialogue with everybody else, they may not look physically as attractive as some other people, but on a computer network you don't know that. When we have gaps in the curriculum, when somebody's sick, the computer will allow us to get the objective that the student had to learn. You can then point out the exact things the student has to know and the best resources to communicate that information, and you can compact it into a very short time frame.

Lastly, I think we have to plan for success. We must humanize software, whether it's for regular ed or special ed. We have to avoid our tendency to self-fulfilling prophecy either to label so that we teach to the label, or to limit ourselves and our instructional goals, or to not be willing to be flexible enough, to make changes right now if a change is needed. I also think that we have to apply more of the research that we have in education. This will happen quite naturally because as computer networks grow, more research information will be available to each of us.

One of the problems about data base and informational data bases has been (a) access and (b) being able to know what's on the data base. The more educational resources and computer resources get on line, the more access we have, the more we will be prone to go to those data bases before we make a decision and those resources will be more widely available.

We need to imitate the success of others. That was one of the things that spurred growth and the advancement of knowledge in the Renaissance. People literally copied the great masters. They sat at the feet of their teachers and learned what they learned. They simply copied or imitated them. NASA and the National Science Foundation have done tremendous amounts of research the public schools could benefit from which is available free, just for a telephone call.

COPYRIGHT ISSUES FOR ELECTRONIC PUBLISHING

Carol Risher

Carol Risher is Director of Copyright and New Technology for the Association of American Publishers, and directs the U.S. Office of the International Copyright Information Center under the umbrella of UNESCO in Paris. A Trustee of the Copyright Society of the U.S.A. and AAP's representative to the State Department Advisory Panel on International Intellectual Property, she is also a member of the Library of Congress Advisory Committee on Optical Disk technology.

The basis for copyright in the United States is the United States Constitution. Article I, Section 8 says: "To promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." "Science" in the Constitution means knowledge. So the whole idea behind copyright is to give the creator the exclusive right to that creation because that encourages the dissemination that encourages people to create and users to get access to the information. Copyright begins at fixation, the moment a work is fixed in any tangible medium of expression, now known or later developed, from which it can be perceived either directly or with the aide of the machine. What am I saying? I'm saying that if you sit at a computer and you create software, just putting codes in, that is protected. You are creating a fixation. If you write a flow chart, if you write notes now, it is protected.

There is nothing that must be done to get that copyright protection. There are only two tests for copyright. The first is originality, originality with that author. Two people could write the same

piece of software and if neither one saw the other's creation, they would each be eligible for copyright protection. It only has to be original with you. You have to have done the original work in order to get copyright protection. There is no test of uniqueness in copyright law. In patent law they go through a long time making sure that nobody else had a similar invention or the same invention. They don't do that in copyright. Only two requirements exist: Fixation and Originality with the author. In the fixation qualification in the 1976 Act, they specifically tried to anticipate new technologies that had not yet been created such as optical disks, perhaps, computer software or microchips, by saying "any technology now known or later developed". The fixation can be perceived either directly, I can pick up a paper and read it, or with the aide of a machine such as when you take a floppy disk and put it in a computer, or if you take a cassette tape and put it in an audio recorder. You don't need to know how to write music to get copyright on a song - just sing it into a tape recorder and it's protected. Software is protected. It was clear in the 1976 Act and further clarified, but the copyright office was accepting registrations way back in '78. The Computer Software Act of 1980 included a definition of software and other language to make sure that there was no question in anybody's mind that computer software was protected by copyright.

Copyright does not protect ideas, only the expression of ideas. This seems to make sense except it's very difficult as you look at the court decision on computer software to know where to draw the line between

the idea and the expression of that idea. It's easy with work like a love story. You can say that lovers fall in love, somebody gets in the way, they go through conflict, and they get back together. That's the idea and anyone could write any number of different novels or plays with that as the idea, without an infringement. With computer software it's a little more difficult. In Atari versus Williams, the court found there was no similarity of expression between "Pac-Man" and "Jaw-Breaker" displays in audio visual games. While in Atari versus North American Phillips, the court found substantial similarity between "Pac-Man" and "K.C.Munchkin" in displays. Why was one an infringement and one was not an infringement? What's the difference between idea and expression? It's not clear. There is a problem.

What does it mean to have a copyright? There are five exclusive rights of a copyright holder. The primary right is to make or to authorize anyone else to make a copy of the copyrighted work. The making of copies is an exclusive right of the copyright holder. The second exclusive right is the right to make or authorize others to make a derivative work - a work derived from the original. In the legislative history you'll see such things as translation being a derivative work, an adaptation or an abridgement being a derivative work. This comes into play frequently with computer software where if someone takes one program and perhaps translates it to another machine, adapts it for use in a particular setup and environment, an adaptation could, by the courts, be perceived as a derivative work. The second exclusive right is the right to make a

derivative work, and the third exclusive right of the copyright holder is the right to distribute copies to the public. Distribution includes sale or other transfer of ownership, by lease, by rental, by license, by giving away or any form of distribution to the public including lease. The fourth exclusive right is to perform publicly. The fifth is to display publicly. These come into play with the other electronic technology including on-line data base.

The Software Act of 1980 specifically stated that an owner of a copy of a program may make another copy or adaptation provided that such copy or adaptation is an essential step in utilization of the program in conjunction with a machine and used in no other manner. If you buy a piece of software, you may make a copy, i.e. you may load it into your machine, which is making a copy in order to use it, and that's not an infringement. You may modify it slightly, put CPM or something on it to make it work in your machine, but for no other purpose can you make the adaptation or the copy. Or you may make a copy as long as such a new copy or adaptation is for archival purposes ONLY, and these archival copies, each one for each copy, must be destroyed if you ever are no longer the rightful owner of the software. If you're the rightful owner because you have a license, and for some reason your license term is up or you returned it, you may not keep the archival copy. These two concepts are very important. These are very severe limitations on your right as a user. This is not what is perceived.

Copies may be transferred with the original as part of a total

transfer. If you bought some hardware and you bought some software and you made archival copies and you are now selling the whole package or giving it to somebody, you may transfer the unit, but only as that package. However, the adaptations may not be transferred. The adaptations may only be transferred with the permission of the copyright holder.

The Copyright Act says that there must be a notice of copyright on copies which are published, i.e. distributed to the public. The copyright office sets forth certain places where this notice can appear. The notice has three elements. The first element is the word "copyright" or the abbreviation "copr" or the symbol "", the year date of publication and the name of the copyright holder. The copyright office has accepted certain deposit copies with the C in parentheses because many of the graphics characters on a computer can't make a circle. They have issued in the Federal Register a document stating that the fact that we accept it does not mean that it will be accepted by a court of law since all of you who are writing software can use either "copr" or the word "copyright" in full so it is not necessarily a safe bet to put a C in parentheses and assume that you have complied with this requirement. Also the C in the circle is the copyright notice of the Universal Copyright Convention. The Universal Copyright Convention is the international treaty. All the countries which are signatories agreed to protect the copyright of other signatories according to their own laws. If a copyright law for any signatory country requires formalities, you must register or you must do that, the use of the C in the circle, the UCC copyright symbol, excuses

those formalities. If on computer software you have a C in parentheses it's really up to each country as to whether it will accept that in lieu of the C in the circle.

Publishers of computer software are faced with many problems. Commercial piracy is where people are taking software, making clones, duplicating and selling them. Commercial piracy is a problem. There are bills pending in Congress now to try and increase the criminal sanctions for that commercial piracy.

More problematic than commercial piracy is private copying. You have clubs. You have people, such as school systems, who say, "We'd like to see your software. We don't know if we want to buy it until we see it. Please ship us a disk or your new program". Then the school will make copies and send back the original saying, "No, we decided we didn't want to buy it." However, they've made a copy for use. There are individual users who are making copies and trading them at clubs which exist only for the purpose of trading software. Institutional copying is a much graver problem. When schools are involved, the numbers are much bigger. We have several cases that have been brought to our attention where entire school systems are under grants from the Department of Education. The grant says they have a quarter of a million dollars for buying software for each of five years, $100,000 for buying software for each of three years - but they do not buy any software. They make copies or they'll buy one and make copies for the 200 or 400 or 600 computers in the schools in the statewide

system and use that money that was earmarked for software in the contract for other purposes. The Inspector General of the Department of Education is investigating several of these cases because this is a big problem at a large level.

Computer software rental is another problem. You may know about the record rental stores and you may know about the video disk rental stores. Right now there's a bill in Congress for the record rental to require a royalty to the record company if the records are rented because it's been proven that the records are rented for one purpose - to make copies. Software rental is not dissimilar. A lawsuit was brought in June of 1983, MicroPro versus United Computer, where MicroPro charged that United Computer, by renting the software, Wordstar and others, was violating the owner's exclusive distribution right because they were making copies available to others. They were a contributory infringer to the exclusive right of reproduction because people who rented the copies were making copies which was a violation of the copyright law, and the store that rented was thereby a contributory infringer. It was aiding and abetting in breach of license because the software was shrink-wrapped. When you break this seal you are entering into a license, therefore you're not allowed to rent or to sell or to copy or to enter into unfair competition. Unfortunately for us, maybe fortunately for MicroPro and United Computer, the case was settled, so these questions of law and how the courts come down are not resolved in this particular case. There was another one on the same shrink-wrap license that questioned when you don't

have both parties there to sign the agreement, whether the license is valid. This is one of the questions which come up with the shrink-wrap license. To say that as you break the seal you are entering into a license is what's being said, but is this binding and is there any way to prove it?

Another problem is that many book stores that are selling software don't like the shrink-wrap licenses because they want to sell software the way they sell books. So the store owner takes the shrink-wrap off so that people can flip through the documentation to see if it's easy to read and look at the software. Does this invalidate the shrink-wrap license? In Louisiana a bill is pending in the Legislature to say that a Shrink-Wrap License is a valid license. They are going to declare it by law but it will only be state law.

In book stores we sell books by putting them out on the shelves and people buy them. But if people don't buy them, we want to send them back to the publishers and get full credit. Book stores that are selling software are demanding the returns policy from publishers.

Protection of software outside the United States is a problem. Many countries have now declared that software is eligible for copyright protection. So even though we're protected in the United States under our copyright laws, other countries are not, and so there is a problem for computer software publishers in selling to other countries.

Another big problem is networking. It used to be that you'd sell software. Section 117 says that it's not an infringement to use a copy to make a copy for your use in a machine. That means one piece of software for one machine. What if a school has 20 machines? What if the school boots in seriatim - one piece of software in each of those 20 machines for the purpose of doing an exercise in computer lab? The sale of software is not like textbooks. Since Section 117 says that it's not a infringement for the owner of a copy to make a copy for use in a machine, arguably you must have one piece of software for each machine. But obviously not all school systems believe that. Networking, linking the machines together by hard wiring, also diminishes the sales potential for the publisher because it makes it possible to take one piece of software and service all the machines in the network.

Publishers can use protection schemes. They can modify the hardware. They can put in special chips and adaptations so that the hardware cannot be used unless you have a certain board that's put in or unless you have a modification. The problem is that the publisher is trying to make sure that his software is user-friendly. A publisher, in trying to work with the school system should not come in expecting the worst but should try to encourage the use of the software. Hardware modification is (1) not seen as user-friendly, and (2) in some cases it affects the warranty. If you put a board inside an Apple or any other computer, you have therefore modified the hardware and sometimes your warranty is not valid.

We are training the citizens of tomorrow when we have to train them to have a place in society by knowing computers. The school systems are also training the citizens of tomorrow to be model citizens. This cannot be done by wanton disregard for the copyright law. This creates a problem for software publishers who want to sell software, who want to be cooperative, and who want our software to be user-friendly. And yet, if the current practice of wanton disregard for the copyright of software continues, many publishers will not be able to stay in the business of creating software, marketing the software, and making it available. Many would-be software creators are refraining at this point from creating software. It's not the type of market where if you jump in first you're going to get the lion's share. It's not the type of market where you can hold off the people who copy ideas. There's a Super-Calc, there's a Visi-Calc; there are many kinds of electronic spread sheets. There are many kinds of word-processing software. Publishers are competing with people who copy the idea, which is not a copyright infringement, with commercial pirates, and with users who are trying to take that limited resource, that limited educational dollar, and make it go the farthest way possible by bending the law a little and making more than archival copies.

Some companies that sell code-breaking schemes advertise that their product is available for "making archival copies." Make archival copies for yourself, make archival copies for your friends, make archival copies for everyone you know. As I quoted to you from the law, archival copies are one copy to be used only for archival purposes if something goes out.

The problem is not just computer software since schools now increasingly use on-line data bases. You have computers, you have terminals, in the library there's a lot of information in the data base. This information is protected by copyright under the copyright on compilation, when you take previously existing material and you put it together. The problem is that many of these data bases are hard to protect because, as I mentioned before, facts are not copyrightable. So if somebody has something like a dictionary in an on-line mode, it's very possible that another could take out an individual word and it not be a copyright infringement - one word, one slight definition. If the entire data base is serially taken down by using a creative search strategy randomly taking down individual pieces of data base, you could in effect make an entire copy of the compilation, violating the copyright law in principal, but not violating it in fact because you have not copied the compilation. Compilation is only protected because of the arrangement and the selection and the presentation of the materials. It's much harder to protect information in a data base.

There are also the arguments that, if I use a creative search strategy and thereby create a new data base, pulling out all the various elements of this, I may in fact be eligible for copyright in my creation. The copyright holder would always argue that this is a derivative work and therefore an infringement of the copyright and the underlying work.

Another question comes about the use of tools and utilities. If

you have a Koala Pad, for instance, and you have created a beautiful graphics program by use of that tool, does Koala have any claim to your product? It depends on the terms under which you purchased or, licensed it. Obviously a tool is meant to be used. If you have not copied the tool, per se, if you have not copied portions of the tool but have only used it to get from here to there, unless their license or their agreement says you cannot, arguably it's fair use. You have created a new product. It's not a derivative product. It doesn't use any of the original. The people from Koala or any other utility will say you could not have created that product were it not for their invention in the first place. Again, it will be up to the courts to determine whether it's a fair use to use the utility for the purpose in which it's intended to be used and create a new product, or whether in fact this is derived from or somehow related to the original work.

The issue has been raised in real cases where a software creator used a utility and was marketing his product and the utility came forward and said, "where's our piece of the action?" That particular utility now has a different license arrangement with people who don't purchase, but license, the software. Can you prove copying if there's no copy of the program. The same analogy would come into play if I used Wordstar and wrote a great book. Does MicroPro have a claim to my book because I used their software to write it? Absolutely not.

Will people buy a utility with a special contract or will they go

someplace else because of this limitation? With software, it's all new and you don't know how the courts are going to come down. With software, with data bases, with any of these things, it's a problem today without a solution. Publishers are anxious to create, to disseminate, to aid in the use of computers in the school system, but as the market becomes less and less attractive because of the inability of our copyright laws to protect, more and more companies re-evaluate that decision to create software. In fact, society is the victim when software is not available. Many of you in schools are also writing your own software. A question has been raised since the copyright law has in it a section that defines what is a work made-for-hire. Copyright protection begins at creation, the creator holds the copyright, but there is one exception to this. If an employee creates a copyrighted work in the scope of his or her employment, somebody is hired to write software, that's what his contract says, that's his reason for being with that company, then the software written by that employee belongs to the employer as copyright holder. This is important. There are also specially commissioned works. If there is a relationship where somebody contracts for the service of the free-lancer and it is known before the work is commenced that free-lancer and employer are agreeing that this is a work made for hire, then that work is a work made for hire and it is the employer who is the copyright holder and not the creator.

In the educational environment the question comes up frequently. If a teacher writes a program, does the school hold the copyright or does the teacher? One could argue, I'll leave it vague because this is the way

it is with the law, that the teacher is hired to teach and not to write software and therefore since it is not the scope of his or her employment, it is the individual and not the school that holds the copyright. Two weeks ago I was at M.I.T. They require every teacher to sign a contract of employment that says that the copyright or the patent for any work created while employed there, will belong to M.I.T. In that case, the contract supercedes what would be a questionable area.

One case was brought on the teacher school situation. In Williams versus Wiser, the school tried to take the lectures of the professor by saying he was an employee for hire; the school was paying him and therefore held the copyright. The court found that a teacher is peripatetic, and if his lecture notes belonged to the school where he taught, he'd never be able to work any place else gainfully again. Therefore the copyright stayed with the teacher. Although it's the only case on the books, this is one question again where those of you who are in the schools should know where you stand. You all have the rights as individuals. This right can be exploited by transferring it to a publisher who will then publish your product for the benefit of everyone in society as well.

Our hope today is that by educating, by raising these issues, by talking about them, people will be more inclined to comply with the copyright laws realizing that society benefits in the end.

ANSWERS TO QUESTIONS

You may make one archival copy of each rightfully owned disk. If someone bends or destroys the original then you still have a single copy. In education, deal with your publisher. If you buy a piece of software and you have 100 terminals in your school system, write to the publisher and say you have purchased one piece of software for one machine. You like this very much and you'd like to make it available to each of our schools. Is there a special mass-purchasing deal? May we under license make copies? Very frequently there are arrangements that can be worked out, and publishers understand what they're up against. Try it. Talk to people and see what happens. I've seen very good results. I've heard from many people that if you ask for permission there is room for negotiations.

It is illegal to make multiple copies. You're breaking the law if you do that. Talk to the store where you bought your program to see if there is a deal on mass purchase. Talk to other stores in the area. Talk to the publisher. Exhaust all the legitimate options within the law to get multiple copies or perhaps a reduced rate or a discounted rate. Do not break the law under penalty of infringement and also for moral and ethical consideration.

People tend to think, "I'm only stealing from a corporation and therefore what's the harm?" The Rand Corporation has just done a study in which they showed that as copying increased, costs to individuals also increased and that society suffered by the illegal copying. What the

Copyright Law says is that certain uses of copyrighted material are fair without the permission of the copyright holder. But there are four criteria to consider in determining what is a fair use.

One is the nature of the copyrighted work. A newspaper article from the New York Times will be treated differently from the score of a symphony. You can decide whether the software is closer to the New York Times or the symphony. Consider the nature of the use, including whether it's a commercial purpose or non-profit education, as well as the portion of the work used as it relates to the work as a whole. Amount and substantiality is what the law says, and what is the effect of the use upon the potential market or value of the copyrighted work? What is the effect of your use on the potential market? Obviously, whether you were making a whole copy instead of buying it has a dramatic effect in that it's not fair use, but there are other considerations in determining whether something is fair. If you were copying a whole work, even if you would argue that you would never buy it in the first place because it costs too much. "The only reason I'm making a copy is because it's available and if I couldn't make a copy I'd never use it." So therefore it's not instead of purchase. That argument doesn't hold water for copying a complete work. You're violating a copyright law.

If you have a lawful copy and you are adapting it and using it in your machine and trying to understand it and it stops there, an argument can be made the same way it was made before Congress that reverse

engineering of micro-computer chips is a way to learn and not an infringement of copyright, because you are slicing it down and studying it and analyzing it. Now, the question is, what if they break the codes but don't swap. Let's come back and focus on this question: is the code-breaking per se an infringement? They have a lawfully acquired copy, they are putting it in their machine. According to Section 117, the input, making the copy, or the adaptation are permitted ONLY if they are an essential step in the utilization of the software in that particular machine. Therefore, the adaptation is not permissible, because it is making of a derivative work.

The purpose of the copyright laws is to promote the progress of science and the useful arts. What we have said to publishers is that in the instance of software with video display, and this is particularly applicable in games, one should register both the underlying software on a TX form and for visual display on a separate VA form. Because it is possible to infringe the visual display with different software, and it is possible to infringe the software with a totally different visual display, it has been suggested to publishers of software that there be two separate registrations for each program: one for the visual display and one for the software. If someone has taken a piece of software that has a particular visual display and, by breaking the code, has learned how that software was written then writes totally different software that results in the same visual display, the infringement would be the registration of the display. If somebody by breaking the code makes a program that does the same thing

or in some way is similar, a copyright infringement case can be brought because one of the tests is whether the second creator had access to the work of the original. If it could be proven in a court of law that not only did he have access to it because it was sold over the counter but he also owned a copy, then the copyright infringement case could be brought even if it wasn't a step by step copy, but there was substantial similarity in structure and concept. The law is clear that copies should not be done. What people do with that is harder to protect against. It goes back to what we were saying with the utilities. Can you prove that somebody used a given utility? Not necessarily. There is a way they can claim that they didn't or claim innocence. It becomes harder to trace the actual infringement.

The IECC came up with a model policy that schools should adopt on use of computer software. The policy tells you specifically what you can, what you are recommended to do and not recommended to do. It tells how a school and how an administrator can, if you will, police what is being done. It recommends disciplinary action against teachers who go against these policies, and it ends with a very strong statement that we are in the business of training the citizens of tomorrow to be model citizens and the only way we do that is by teaching them to be law abiding citizens and by setting a good example. The policy specifically states that archival copies will be made by such and such a facility and purchases will be handled thus, and there's a set format for the use of computer software. IECC did this on the IECC Board during the drafting with somebody from a

California school district with a model policy. Many schools do have their own policies for the use of software. It's something that we recommend at a school board level. My suggestion is that at the administrator level you and others get together and say you think it would be a good idea for this school to have a policy. More software and more issues will come up and here's a model that has been adopted by several school with good results. Then you educate by having a model that says that students may not use pirated software on school equipment. They say in the IECC, teachers may not use pirated software on school equipment. They may not use school equipment to make copies. It goes through all the possibilities and makes it very clear at the administrator level what is expected as acceptable behavior by the faculty and what is not. Then you have something specific. You don't just say "I know you're breaking the law." We have received in the AAP office phone calls from frustrated teachers and administrators who say so-and-so in our school is doing the following. In some cases, with photocopying where the law has been around a lot longer, we're quicker to call together the publishers and ask if they want to sue, do they want to write legal letters? With software we feel that we have to educate the schools. In many cases people don't know they're violating the law. It's one of those "everybody's doing it, why can't we?" situations.

If you're only using it on one machine at a time, the law says "a" piece of software for "a" machine. Clearly it's a violation if you make a copy so that you and your wife and child can all be working at the same time because you're making a copy. It talks about the input which is

making a copy into the machine which is okay for the purpose of utilization.

What if we have a computer lab in the school and there are 20 pieces of hardware and we have only one of each piece of software and the students can come up to the front of the room and pick only one, because we're not making copies. Is there a problem in that? While Johnny's using a word processing package, Mary can be using a spreadsheet, and somebody else is using something else, and you put it back at the end of the day. Is it an infringement, is it a problem because it's not linked? Maybe you have a better answer for what some publishers are doing.

What some publishers are doing is selling per machine or giving you a license. They sell this software for "X" and for each machine beyond "X", the price is "Y". I don't know if there are any better answers on this. People are writing this into contracts to clarify where there is a question. The first example - I had one machine and I bought another machine the software works on, so while one is down or while one is using something else, does it say on the software this is only for Machine "A"? I think an argument could be made, if you're only using it one at a time, but not in seriatim loading. When you store it in the memory, you're making a copy. That is a copy. You make a copy for the purpose of utilization. "A" is singular - it doesn't say copies or many copies. So once you have made the single copy for the purpose of utilization, that's it. When you turn that machine off, if tomorrow you walk to a different

machine and make a copy for the purpose of utilization, an argument could be made that you're not violating the law unless there is something otherwise.

If you remember, we sued New York University and in that lawsuit we sued the professors, we sued the university, and we sued the copy shop. We had no question we would win if this went all the way, but it settled. The university immediately accepted responsibility for the behavior of its faculty. With the elementary schools and school districts, we would sue the superintendent. We would sue the school district. We would sue the school board. There is nobody who would be free of this. It's not just the one teacher who made the copy.

This is what would happen. Let's play court for a moment. You have a policy which a teacher is infringing. You come forward in your defense and say, we have a policy. The publisher comes forward and says, yes, you had a policy, but you didn't publicize it. You knew people were blatantly in front of you violating the law, and you didn't take any steps to correct it. You didn't enforce your policy. What's the good of your policy? We say that that was a bad faith effort and you would have to argue, oh yes, we did take steps. We did publicize it at every meeting. We handed it out to every new teacher. We gave advisories several times during the year. We mentioned it at each new semester. If you could say that and say that we had no knowledge and prove you had no knowledge this was going on, that nobody told you. The walls have ears. Even a student

will say, I heard Mr. Smith say how he was expanding his resources by not buying copies but making extras. That's what would come out in a court. How it would be determined one doesn't know. Obviously if you have a policy and you enforce the policy and you publicize the policy, you are in much better shape than if you have none.

Legally it is unclear what the law says about networking in the absence of a contract. What the law says is: A program may be loaded into one machine at a time, but it doesn't say at a time. You could say on a day, or you could say it's only loaded into one machine so therefore that's all right. What is the effect of your use on 20 machines? Is it to save you the buying of 20 copies? Would you normally buy 20 copies? It's something that probably would be a good idea to clarify. I know that the people who are getting into networking write to the publisher and request an un-copy-protected disk to load onto the hard disk to run the network (hard wired) system. They get back a letter saying, the publisher will be glad to send you an un-protected disk for the purposes outlined at an incremental price of "X" per machine. How many machines will be operating on this network? Then if they use the hardware modification method, the chip or the board or whatever the hardware modification is for that number of machines is provided.

The exclusive right of the copyright holder is the right to control the distribution and the making of copies. The decision of what to charge is exclusively that of the copyright holder. Therefore, we have in

operation a marketplace. If a particular program is not worth the incremental cost, then you write back to that publisher and say, thanks but no thanks. Then on another package you decide that it is worth that cost, and eventually, not today, the marketplace will decide. They will either lower the cost because they want your business or raise the cost because everybody's paying it. If there are more people out there who want a particular package, they can handle it. Developmental costs are great, excessive, high. Piracy is taking its toll. Illegal copying is hurting everybody, including the honest users because it's causing the prices to go up and causing a tremendous problem to everyone. Therefore there's less and less software available rather than more and more, and fewer and fewer, very sophisticated powerful tools being created because of the fear that they cannot be protected. Instead, what's happening is that consultants are going to the corporate environment, they're designing a particular piece of software for the corporation with a very tight contract and the over-the-counter, easily available software is getting the short shrift. It's because people aren't self-policing. When there's more respect for copyright and more communication between the users and the publishers, there will be more quality software that people will take the risk on.

I am Director of Copyright for Association of American Publishers. What people want is a place for anyone in the world who has a question on copyright to call. If I don't have the answer, I have lawyers and resource people where I can get the answer. You can call with any questions.

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BEYOND INSTRUCTONAL COMPUTING: PREPARING STUDENTS FOR THE ELECTRONIC AGE

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Introduction

Imagine for a moment that you live in the best of all possible worlds. The students in your school are making remarkable progress and have mastered all the content in the curriculum and more. Is there still some way that you can use your computers for purposes other than providing reinforcment and playing games?

Now reverse the situation. Your students are making dreadful progress, and even if you stumbled upon the most effective methods and materials in the world, it would still take them several years to catch up with their overachieving peers in the next district. Is there some way

that you can use your computers for purposes other than reinforcement and the tedious basic skill instruction your students are receiving already?

The answer to these parallel questions is an emphatic "Yes." In both instances, and in the real world that falls somewhere between the two examples, it is only necessary to look beyond instructional computing for your direction. Perhaps the most beneficial use of the computer for the majority of students is to prepare them for the electronic age in which they live.

In order to accomplish this purpose, it is helpful to consider the world of work that awaits today's students. Focusing on employment is reasonable because it is a significant facet of life that is being radically affected by technology. Moreover, success in the workplace allows individuals to pursue the style of life that they desire.

For the purposes of this paper, we shall discuss several aspects of computer technology that are influencing business and industry. They are computer assisted design (CAD), electronic publishing, and robotics. Of course, other areas of technology are having an impact on business and industry, but these three areas will influence a large number of jobs and are easily introduced into the school curriculum.

Before continuing, it is well worth mentioning that disadvantaged as well as advantaged students should have an opportunity to progress

beyond instructional computing. It is too often the case that students who have not mastered basic skills are given access to the computer only for instruction in the subjects in which they are deficient. They never learn how to manipulate the computer as a tool because they are always in a reactive posture. Basic skill instruction is certainly critical for these students, but it might better be undertaken using traditional methods. The computer can then be used to give these students a greater sense of control, to promote higher-order thinking skills, and to prepare them to succeed in the competitive workplace they will enter.

Computer Assisted Design

The design of a new product has always been a laborious process that involved teams of engineers and drafting professionals. It was so time consuming and expensive that many promising ideas have been abandoned before their potential could be fully explored.

With the advent of computer assisted design (CAD), product development has reached a new level of efficiency. Computers equipped with specialized software and input devices such as light pens or graphics tablets now make it possible for a professional working alone to complete in a matter of weeks what previously took a team of specialists years to accomplish. CAD systems are relatively expensive, but some are so affordable that even small companies can take advantage of the new technology.

The process of CAD is straightforward. Data describing the specifications of a new product are entered into the computer along with a graphic image created by a technician. The computer can now be used to enhance or modify the image, or to test the specifications under various conditions. CAD systems can perform tasks as simple as suggesting arrangements for furniture in a room or as highly complex as planning the layout of an oil refinery.

School students can be introduced to computer assisted design in two ways. Secondary students can gain experience through specialized software such as VersaCAD (T & W Systems, 7372 Prince Drive, Suite 106, Huntington Beach, CA 92647) or Benchmark (Metasoft, 6509 West Frye Road, Suite 12, Chandler, AZ 85224). At this level, their experience is direct preparation for future employment or for further training at the post-secondary level.

Both primary and secondary level students can be introduced to CAD through graphics development programs such as Micro Painter (Radio Shack, One Tandy Center, Fort Worth, TX 76102) or Delta Drawing (Spinnaker Software, 215 First Street, Cambridge, MA 02142). A slightly more challenging program is the Pinball Construction Set from Electronic Arts (2755 Campus Drive, San Mateo, CA 94403). This introduction should be informal, and the entertainment aspects of the software should be emphasized. There is no need to stress that graphics development has a place in the real world; students will find this out soon enough. Just let

them enjoy the experience and they will incidentally acquire some very useful skills.

Students who may never be involved with computer assisted design should also have an opportunity to work with graphics development software. The experience will make them more familiar with the capabilities of the computer, promote higher-order planning and thinking skills, and give students the opportunity to work creatively with a computer.

These comments about graphics development systems hold just as true for music development programs. Although there is not the direct transfer to CAD that there is with graphics, music programs incorporate virtually the same features as graphics programs, but in another modality. Player Piano (Atari Program Exchange, PO Box 3705, Santa Clara, CA 95055), Computer Composer (Basics and Beyond, Pinebridge Road Box 10, Amawalk, NY 10501), and the Music Construction Set (Electronic Arts, 2755 Campus Drive, San Mateo, CA 94403) are just a few of the many music development programs available for microcomputers at a reasonable price.

A comprehensive discussion for computer assisted design can be found in the January, 1984 issue of BYTE magazine. The articles are technically oriented and thorough, and are especially appropriate to teachers and administrators at the secondary and post-secondary levels.

Electronic Publishing

Publishing is one of the most traditional industries, yet even here computers have proliferated. At major magazines, for example, the entire publication process may be electronic. Reporters enter stories through a terminal connected to a large computer; in some instances, they may do this in the field by using a modem and a standard telephone connection. Editors then can make changes to the story electronically, and the production staff can format the stories, other features, and advertisements so they fit on the pages correctly. Formatted pages are telecommunicated to electronic typesetters that may be hundreds of miles away; sometimes this telecommunication may take place via a satellite. The magazine is printed at an electronically controlled plant and may even be part of an on-line data base that can be accessed through a computer equipped with a modem.

Book pulishing follows a similar pattern, but because time is not of such critical importance, everything moves at a more leisurely pace. Authors may send diskettes to publishers rather than two-pound paper manuscripts, or they may telecommunicate their work directly through the phone lines. Editors and the production staff then work on the manuscript at terminals, and if all goes well, the finished book may reach its final form without ever making a preliminary appearance as paper galley proofs.

The best way to ready students for a career in publishing is

through word processing software. There is an enormous variety of word processing software available for microcomputers, most of which is priced reasonably. Some word processors such as Milliken Writer (Milliken Publishing, 1100 Research Boulevard, St, Louis, MO 63132) and the Bank Street Writer (Broderbund Software, 17 Paul Drive, San Rafael, CA 94903) can be used by primary grade students. The more sophisticated programs can even set type.

There are two principal ways in which students can be introduced to word processing. The most obvious way is by teaching composition with a word processor. This practice avoids much of the drudgery associated with the writing process, and capitalizes upon the inherently motivating aspects of the computer. There is a growing body of literature about computers and composition, as can be seen from the bibliography at the end of this paper.

A second way to introduce students to word processing is through a class or school newspaper. This approach has the added advantages of giving students a reason to write and providing them with an audience. Composing a class or school newspaper on the computer closely resembles publishing as it is actually done electronically, and is an ideal career development activity.

Most discussions of electronic publishing focus on professional applications, yet a very significant future use of the computer in publishing will be by amateurs. Countless social, athletic, religious, and

community organizations issue newsletters of one kind or another, and students who work with word processors in school will be better able to participate fully in the nonprofessional publishing industry.

Robotics

The Industrial Age has evolved into the Technological Age, and nowhere is this evolution more obvious than in America's heavy industries. Computer controlled robots in durable-goods factories now perform many of the repetitive or dangerous tasks that were once done by blue-collar workers. The use of robots is expanding into other areas of manufacturing, and the first "personal" robots for home use have already made their appearance.

Preparing students for a life in which robots will be commonplace can be an enjoyable and affordable experience. The best way to begin is with the LOGO language; after all, isn't the turtle on the monitor just a two dimensional robot? Students who learn LOGO acquire an understanding of the fundamentals of robotics and are well prepared for more formal instruction.

The obvious step after LOGO is programming a mini-robot such as Big Trak (Milton Bradley) or Turtle Tot (Harvard Associates, 260 Beacon St., Somerville, MA 02143). Both elementary and secondary students have little difficulty generalizing what they have learned in LOGO to

mini-robots, and these devices are very affordable. The April 1984 issue of Teaching and Computers (p. 26) has an interesting article on how one teacher is using Big Trak to teach science, social studies, math, and even language arts.

The transition from mini-robots to their more powerful counterparts can be an expensive proposition. Although Androbot (101 E. Daggett Dr., San Jose, CA 95134) offers two models for under $500, most personal robots cost $1500 to $3000. The least costly personal robot is a do-it-yourself kit from Zenith Educational Systems (Benton Harbor, MI 49022). The cost of robots will, however, drop sharply as they are manufactured in greater numbers, and it is likely that the next few years will see the prices of robots plummet in the same way personal computer prices have.

As you would imagine, students react quite favorably to robots. They take to robots as readily as they do to computers, so you can imagine how strong the affinity is. For a good description of what you can expect when kids meet robots, refer to the March 1984 issue of Classroom Computer Learning.

One aspect of robotics that can be pursued inexpensively is sensory input. Robots must respond to sources of stimulation from the external environment such as sounds, visual clues, pressure, and temperature. To introduce students to sensory input, you don't even need a

robot. A microcomputer equipped with inexpensive peripheral devices will do just fine.

You can buy peripheral devices like a temperature sensor (Cambridge Development Laboratory, 36 Pleasant Street, Watertown, MA 02172) for under $300. A more economical approach is to build your own sensory input devices. An article in the February 1984 issue of Micro provides step-by-step procedures for assembling sensory input devices from inexpensive parts available at any Radio Shack store.

Related to the concept of sensory input is instrumentation, the generic term that refers to the automatic measurement of physical and chemical processes. For example, peripheral devices connected to a computer are capable of measuring electrical potential, and so can be used in chemistry to determine the properties of solutions, in physics to measure the resistance of a substance, and in psychology to evaluate galvanic skin response. Because the peripheral device is connected to the computer, measurements can be made over time and stored without being monitored by a student or teacher.

A comprehensive discussion of instrumentation entitled "Pixels and Pendulums" appears in the March 1983 issue of Classroom Computer News. A table that accompanies the article lists a number of commercially available instrumentation packages that can be connected to many of the microcomputers that are used in schools today.

Conclusion

Microcomputers are the most versatile instructional tools available to educators today. In addition to promoting the acquisition of important basic skills, computers can serve as the vehicle by which students are prepared for the world of work they will enter as adults, a world in which the computer will play an ever-increasing role. This paper focuses on only three applications of the computer in business and industry--computer assisted design, word processing, and robotics--but there are dozens of other ways in which computer technology is revolutionizing the workplace. In planning to move beyond instructional computing, there are several factors that should be kept in mind. The first is that students of all ability levels should have an opportunity to use the computer for noninstructional applications. This practice will make it more likely that low achieving students will be able to compete seccessfully for the increasing number of jobs that require some knowledge of the computer.

Second, although the applications discussed in this paper go beyond instructional computing, they should be integrated in some way into the existing curriculum. Computer assisted design might, for example, become part of the art curriculum, word processing might be one aspect of language arts instruction, and robotics and sensory input might find their way into the science or even the social studies classroom. The more that the computer becomes part of the everyday process of education, the sooner

will its use become associated with significant positive changes in the attitudes and abilities of students.

Finally, moving beyond instructional computing should be a pleasure for both students and teachers. The computer provides countless ways that fun can be brought back into the classroom and demonstrates clearly that learning need not be drudgery. With a little imagination and enthusiasm, teachers can ensure that the computer is used to prepare their student for tomorrow's world in a way that is both enjoyable and productive. And isn't that what school should be like anyway?